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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| The first issue of | | | | 1888 cont'ined | 175 | different | adv'ts. |
| 1881 contained | 28 | different | adv'ts. | 1889 " | 234 | " | " |
| 1882 " | 45 | " | " | 1890 " | 289 | " | " |
| 1883 " | 63 | " | " | 1891 " | 325 | " | " |
| 1884 " | 82 | " | " | 1892 " | 316 | " | " |
| 1885 " | 100 | " | " | 1893 " | 317 | " | " |
| 1886 " | 138 | " | " | | | | |
| 1887 " | 154 | " | " | | | | |

No announcements of the Publisher are included in this list.

ACTUAL NUMBER OF COPIES PRINTED.

| 1892. | | 1893. | |
|---|---|---|---|
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| " 17th | 11,500 | " 21st | 12,250 |
| " 24th | 11,750 | " 28th | 12,250 |
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**The Design of a Central Station for Incandescent Electric Lights.**

WE commence in this issue an extended article by Prof. E. P. Roberts on the above subject, which is timely and exceedingly appropriate to the occasion. While the subject itself is one that many have essayed to treat, it is one that must ever be most important to both the engineer and his clients. Prof. Roberts in his incisive way of putting things, and from the authority with which he speaks, is sure to attract attention, and we commend the close perusal of his several articles by all within whose reach they come.

**Water Capacity of Boilers for Central Stations.**

MR. HALPIN'S plan for storing heat in water for central stations, mentioned in our previous issues, would make it appear that it might be an advantage for central stations to use boilers having a large water capacity, instead of using quick-acting boilers of small water capacity. If this is an advantage it is one which can easily be had in stations which are at present contemplated without any additional risk or cost; at all events it is a point which is well worth considering by those who construct and run central stations. The subject of thermal storage of energy is one that has been attracting considerable attention of late abroad, and that interest has already extended to this country. Prof. George Forbes has therefore chosen a most timely subject for his paper before the National Electric Light Convention, and it will be listened to with the utmost attention.

**The Present Issue.**

IN order to be able to present THE ELECTRICAL WORLD to each of the visitors to St. Louis who go by the Electrical Special which leaves New York City at high noon of Sunday, February 26, and that most of its other subscribers may receive it by mail before the convention, we go to press somewhat earlier this week than usual. As our readers will observe, however, this object has been achieved without sacrificing either size or quality. On the contrary, we think this number will be found to be of especial interest. As regards size, it is fully up to the mark, consisting of no fewer than 76 pages, with 375 distinct and separate advertisements, not including the announcements of the publishers. We think this number is truly a cause for congratulation to all those in interest, for it shows in a most unmistakable manner the great activity of the electrical industry in spite of litigation and competition.

**The St. Louis Convention.**

AS THIS is the last issue of THE ELECTRICAL WORLD previous to the St. Louis Convention it is appropriate to announce at this time the programme we have laid out for ourselves for the immediate future. In accordance with its usual custom THE ELECTRICAL WORLD will issue during the time of the meetings a daily bulletin, in which will be chronicled all the incidents of an interesting nature that transpire on this most interesting occasion. These bulletins will be issued early each day, in time for distribution before the meetings convene, and, besides giving the announcements for the following day, will present an epitome of the preceding day, which will be given in greater detail in our regular issues, which immediately follow the final adjournment. We wish it understood that these bulletins are intended for gratuitous distribution, and bring to us no direct returns except the pleasure and assistance they will give to our many friends. We shall fail of our object if they do not prove both interesting and valuable, and our friends will greatly assist us if they will leave at our quarters—the gentlemen's parlor at the Southern Hotel—any items of interest of which they may become possessed.

**The K R Law.**

IN our issue of the 25th we devoted considerable editorial space to a discussion of the K R law in telephonic transmission. In this connection we would call attention to an article on the effects of self-induction in a distributed static capacity in a conductor by Profs. Bedell and Crehore, which appeared in our issue of Dec. 24, in which they have treated the subject from a mathematical standpoint, and have come to the conclusion that the difference in rates of propagation and decay of waves of high and low frequency constitutes the limits to the use of the telephone. They say that as the several harmonic components of a complex tone advance along the conductor they keep shifting their telephonic phases according to the difference in their rates of propagation, and also change their relative intensities according to their difference in the rates of decay, thus changing the resulting combination tone and materially altering its quality. These effects are always present in circuits containing distributed static capacity, but are not so marked when there is also self-induction. Those who are interested in the analytical discussion of self-induction and distributed static capacity in a conductor will do well to peruse this article with care.

**The Cat or the Office Boy.**

THE slight *faux pas* recently committed by one of our contemporaries, to which we briefly referred in our last issue, seems to have attracted more widespread attention in electrical circles than is usual with ordinary events. Although THE ELECTRICAL WORLD did not appear on the streets until Wednesday, we have received, up to Friday, six letters and two telegrams condoling with us upon our squelched (?) condition. Most of them extend through us their sympathy for the unfortunate contemporary, which we freely transmit by these tokens, and some suggest to the same publication various remedies which they warrant will preclude repetition. Some of these are too lengthy for publication at this time, but may form the basis for a special edition when all the returns are received. But there is one that deserves repetition at once, and that is that our esteemed contemporary get a good intelligent cat to replace the office boy should he again be so remiss as to neglect his duties. We believe it was Mr. Dana, of the *Sun*, who first suggested this idea, and claimed that the cat was superior to the boy for the purposes mentioned. We commend this advice to our esteemed contemporary, but would suggest that it procure if possible an *electrical* cat as more likely to be conversant with technical terms. N. B.—The kind of cat that don't spark when rubbed the wrong way in the dark is *not* an electrical cat.

**Conductors and Insulators.**

WE print this week the first of a series of articles from the pen of Mr. Reginald R. Fessenden on conductors and insulators. While this may seem to be a somewhat hackneyed subject, it is one of the utmost importance to the electrical interests, and will continue to be as long as electricity remains of interest on this mundane sphere. Mr. Fessenden attacks the question from a standpoint that will be new to the most of our readers, but from one that is of the utmost interest to the more technical, especially to those who are working in the line of molecular physics. That a knowledge of the shape of the atom and molecule will lead us to a better understanding of many of the physical and chemical phenomena which are now enveloped in mystery has long been felt and many have labored to get an insight into this little explored field. Mr. Fessenden refers to it in the title, "Stereotomy of the Atoms." It has also been called "Chemistry of Three Dimensions," but the literature on the subject is limited, and so scattered as to be accessible to few. The problem, too, has been attacked from such different directions, and with such dissimilar objects in view, that what little literature there is on the subject seems hardly connected. Thus the chemist seeks to solve by his investigation the valency of the atoms and the structure of the molecule, and to differentiate thereby the isomeric compounds, whilst the physicist seeks among other things to go back even of this, and to discover how the arrangement of vortex rings may give rise to the different forms of matter, and incidentally the properties which characterize them. The use of this knowledge in the discussion of electrical conductivity is an obvious result of the exploration of this field, and Mr. Fessenden will be followed with close attention as he develops his subject from this standpoint.

**Beginning Our Twentieth Year.**

THE ELECTRICAL WORLD with this number steps out of its teens and looks back upon a career of uniform and phenomenal prosperity which began with its first issue of modest dimensions bearing date of March 1, 1874. For that and a number of succeeding years it bore the name of *The Operator*, and consisted at first of a four-page sheet of just about one-half the present size. This was issued but twice a month and was devoted exclusively to telegraphy. As the electrical field broadened with the advent of telephony and commercial electric lighting, departments under appropriate headings were added to meet the new fields that it was aimed to cover. But as the importance of these departments increased, the paper outgrew the significance of its title, and the latter was changed in 1883 to the more ambitious ELECTRICAL WORLD, by which the paper has since been and is likely long to be known. Like Alexander the Great, Julius Cæsar and the Duke of Wellington, the three great generals who were never defeated, THE ELECTRICAL WORLD on the threshold of its twentieth year looks back with pride upon an unbroken series of successes. With never so many subscribers, so many readers or so many advertisers as it has to-day, the augury for the future seems bright and the omens auspicious. Having wielded in the past an influence in the electrical field unapproached by that of any other periodical, its aim for the future will be ever to maintain this enviable prestige so honestly won. As regards circulation, it is believed that no other three electrical journals in either the New World or the Old have a combined circulation equal to that of THE ELECTRICAL WORLD, and it is the only electrical periodical on the face of the globe that prints on its editorial page its exact circulation. It would be affectation to say that we are not proud—even jealous—of the leading position this journal has held for so many years, for it is a source of intense gratification to us, and it will be our constant aim to push onward and upward, meriting the confidence of those whom we serve. In beginning its 20th year, with its 20 pages of reading matter and its 56 pages of advertisements, THE ELECTRICAL WORLD the journal greets the electrical world its readers with best wishes for continued prosperity and happiness.

### The Province of the Class Journal.

The birthday is an occasion which suggests to one's mind the propriety of retrospection, introspection and circumspection. Like the beginning of the new year, it is not only an occasion for a survey of the past, but for plans for the future, and The Electrical World, in the first number of its twentieth year, wishes to say a few words on a subject that concerns its readers and itself.

The class, or technical, or as it is perhaps more frequently called, the trade journal, occupies a somewhat unique position in journalism, which can be best illustrated, perhaps, by its differences from, rather than by its analogies to, the daily paper and the literary magazine.

While literary excellence is desirable in all, it is not the prime essential in the trade journal. The same may be said of news; for, however desirable a feature this may be, the very nature of the publication, occurring at greater or less intervals, precludes its being in the strictest sense a newspaper.

Its proper function is that of a review; but as such it should bring the history of that of which it claims to be the exponent down to as late a date as its day of issue will permit; and in this age of rapid accomplishments and severe competitions, that review which declines to hold open its forms for an hour or two to include some anticipated achievement or to cover the same with a supplement, when the announcement is of sufficient importance, must be distanced in the race for supremacy.

The telegraph and the cable and the telephone are brought into requisition to-day by the more enterprising of the technical journals, where before they were used for news gathering solely by the daily press.

Thus the weekly trade paper or review trenches closely on the heels of the newspaper, and that one which most successfully combines the two functions finds the greatest favor among those whom it serves.

Its character as a review, however, places limits upon its functions as a newspaper, for it has failed of its mission if the pabulum it serves lacks digestion.

The weekly or monthly has no excuse for existing if its utterances are frivolous or its statements unweighed. The editorial staff, personified by "we," is not composed of individuals solely, but of opportunities as well. There is no individual whose experience is so broad or his opportunities so great as that of a properly constituted editorial staff.

The editorial sanctum is the centre where all wires should converge, and must serve as a recipient for both metal and dross. It is the province of the editor to select from this store that which is essential, without fear or favor. Both sides to a question should be fairly presented to enable his constituents to judge for themselves. His own broader views may give rise to opinions, and as such are usually respected if they are honest and really possess merit.

The view of the "ego" is seldom desired, and the self should give way to the appropriate "we." It not infrequently happens that the two get confused and "we" is employed where "ego" should be. This confusion, however, seldom extends beyond the editorial mind, for his constituents, as a community, know more than he, and are quick to discern the wheat from the chaff.

Trade journalism has no place for an organ, for that implies a divided house. The field of a trade paper is the whole of the field, and the interests of the individual must give way to that of the trade. The organ is the tool of a party or clique, and as such finds uncongenial climate in this territory. The doctrine of evolution holds good in journalism as elsewhere, but while a simple survival is not perhaps of itself proof of great fitness, a persistence through changes shows fitness of type.

As has been indicated before, personality, whether it be the editorial, in which the individuality predominates, whether it be of a complimentary or derogatory character, as applied to a contemporary journal or individual, should be subordinated to conventionality in its broadest sense. This implies breadth of view, the ability to give not undue prominence to accidents or sporadic occurrences. It includes the faculty of the mathematician, who discusses general formula rather than individual cases, and, like the mathematician, subordinates specific facts to general truths. In no direction is this quality more essential than in that special class of journalism embracing in its province the sciences. Yet nowhere does it seem to be less prominent. In medicine there may be some excuse for this, for medicine is not yet an exact science; but in electrics, which within well marked bounds is as exact as mathematics itself, there is little and should be none.

In electrical industry, however, as distinguished from the science pure and simple, we should strive by all means in our power to suppress this objectionable feature which, despite good intentions, will occasionally creep in.

An illustration of the case in point came to the surface during the recent lamp litigation, which divided the electrical interests by an impassable gulf. The interests of one party seemed irreconcilable with those of the other, and the tendency of the press was toward partisanship. While the interests of one were opposed to the many, were the interests of either subserved by this partisanship? An ephemeral popularity may be gained, it is true, by presenting ex parte statements and holding out to one side false hopes that are doomed to destruction.

The neutral wire may be despised because of its name, but this of the three alone cannot be spared. The efficiency of the three-wire system reaches its highest development when the neutrality of the middle wire is most nearly attained.

The paper which is always striving to keep on the popular side and disregards principle for the attainment of that end, may succeed for a while, but must eventually lose cast among sensible people who see that nothing has been gained, though they themselves have been amused by the seeming disinterestedness of their, for the time being, champion.

The partisan paper that descends to hyperbole, weakens its case and does the cause harm. However adversely our affairs are affected by current events, we eventually turn to that dignified paper which fearlessly confines itself to the facts, though by so doing it for a time seriously jeopardizes its popularity. While the story it tells may not be the one we wish to hear, nor, in fact, the one it would prefer to tell, the mere fact that it is true and can be relied upon, is worth to us more in our calmer moments than all of the fireworks which pleased at the time.

The cry of the partisan that the motive is mercenary is the reverse of the fact, for how can the favor of the few outweigh the favor of the many? A little calm reflection will show most conclusively that it is the partisan that is mercenary and not the conservative. The cry of the former is the cry of the thief, who evades his pursuers by joining in the chase of an imaginary thief of his own creation and, by thus distracting attention from himself, for a time, seeks to escape the penalty of his own sin.

In times of excitement some of us are inclined to regard with suspicion our very best friends, and it is then that we find it least possible to take conservative views. A feeling of resentment is not infrequently aroused at such times, by statements of facts that do not coincide with our views. When we are excited the whole world must be excited to meet with our approval, and he who pours oil on the flames strikes a chord in harmony with the discord of our thoughts. We are apt to applaud at such times what at others we condemn, and of which we are ashamed when we return to our senses.

To conclude, it may be said, without fear of contradiction, that the province of the technical journal is to preserve a dignified neutrality in times of excitement, to be just, and, above all, to strive to be right. It should be fearless, non-partisan and technically, as otherwise, correct. It should be above petty jealousies and avoid personalities. Pedantry should not be its forte. Its educational obligations lie in the direction of furnishing facts upon which sound opinions can be formed by its readers, and not, as assumed by some, of furnishing opinions ready made for its patrons. That editor has missed his vocation who assumes for a moment that his clients are ignorant and incapable of forming opinions themselves when the facts are presented, and he reflects on the intelligence of his readers when he attempts to decide for them which way they shall think.

### The Telephone Situation.—II.

It has been generally assumed that the Berliner patent issued on Nov. 17, 1891, on account of the breadth of its claims, covers all practical forms of carbon transmitters, and that the possession of this patent by the Bell company will serve to continue the protection of the monopoly of essential devices enjoyed by that company under the patents of March 4, 1876, and Jan. 30, 1877. This famous patent is now in the way of gaining additional notoriety by reason of the suit brought by the Attorney-General to annul it. In the brief of the United States in these proceedings, which will probably take an important place in the famous legal struggles in which the commercial history of electricity is so rich, there are shown many causes why the patent should be declared invalid. One is the long delay in issuing the patent, which gives rise to the state of affairs mentioned in the last article, i. e., endowing subsidiary patents with a life nearly double that of the legal terms; it is alleged that the Bell company designedly delayed the issuance of the patent with this very object in view. It is further alleged that the specification, drawings and claims were entirely altered after the application was filed, and that the patent issued described a very different invention from that described in the original application. Other grounds calling for the annulment of the patent are stated to be that a patent issued to Berliner in 1880 covered precisely the same apparatus, that Berliner was not the original inventor anyhow, as the invention was in prior use by Edison, and that the Bell company was aware of this. As regards the action of the Patent Office in connection with the matter, it is charged that there were many irregularities, errors and unlawful acts on the part of Patent Office employees, which form additional grounds for invalidating the patent. From this brief summary it will be seen that the government has made out a pretty strong case against the obnoxious patent, and, as it is promised that great activity will be shown in pushing the proceedings, the case will be watched with much interest by all concerned in telephone matters.

Whether the Berliner patent is upheld or not there are certainly three transmitters employing carbon or some other "semi-conductor" for the variable resistance which are outside its claims. One of these is practically public property now; the patents on the other two have nearly their full life to run. We refer to the Hunning, Cuttriss and Clamond transmitters. The principle of the Hunning transmitter, as is well known, is the employment of granulated carbon for the variable resistance, the two "electrodes" of the primary circuit not being in contact with each other except through the granulated carbon. All the claims of the Berliner patent refer to the "electrodes" in constant contact with each other, and these claims could scarcely be interpreted as covering an arrangement in which the "electrodes" are separated by a layer of granulated carbon. The Hunning transmitter was patented in England on Sept. 16, 1878, and in this country on Aug. 30, 1881. The British patent expired in September of last year, and, as the British patent was issued before the American patent was applied for, there can be little doubt in this case that the American patent was limited by the foreign one, and that the Hunning principle of using granulated carbon "not in any way compressed or consolidated" is now public property in this country. The importance of this lies in the fact that the most powerful transmitters known are those employing granulated carbon for the variable resistance. Both of the more modern forms of transmitter put out by the American Bell Telephone Company to meet the requirements of long distance talking are modifications of the Hunning instrument with granulated carbon for the variable resistance and "electrodes" not "in constant contact." It should not be at all difficult to devise other forms of granulated carbon transmitters which would not conflict with the existing patents on the details of the modifications of the Hunning principle.

The Cuttriss transmitter, patented in November, 1891, has no "electrodes." The variable resistance is a small spiral spring of carbon, the convolutions of which are separated and brought closer together by the vibrations of the diaphragm acting on one end of the spring. The opening and closing of the spring cause diminution and increase of resistance. The entire absence of "electrodes in constant contact" from this arrangement leaves it outside the claims of the Berliner patent.

The Clamond transmitter, which was recently described in these columns, was patented in this country in November, 1892. The principle is a sort of extension of that invented by Hunning. M. Clamond incorporates the carbon or other conducting material which is to form the variable resistance with a viscid substance, so as to make a plastic mass having conducting power. This he places between the electrodes, the plastic variable resistance being contained in an elastic covering which permits it to expand or contract in accordance with the vibrations communicated by the diaphragm to one of the "electrodes," which is acted upon by the diaphragm. In this transmitter the "electrodes" are not in "constant contact," and the variations of resistance are not produced by variations in the pressure of one "electrode" upon the other, but the changes in the cross-section of the plastic conducting material between the "electrodes"; consequently, this combination is also outside the Berliner patent.

It is worth while to inquire why all the workers in the interesting field of telephonic transmitters have clung so persistently to the use of carbon "or other semi-conductors." The object is to produce a variable resistance capable of as great a range of variation as possible from its normal resistance. If the normal resistance is high, the changes must be very great to have a proper effect in varying the induced currents in the induction coil. Starting with a low resistance, the changes might be of much lesser magnitude and still bear the same ratio to the normal resistance, while producing a more powerful effect in the induction coil. It would seem, then, that a transmitter having a variable resistance composed of a good conductor might be just as effective as one employing carbon or "semi-conductors." We think there is a good field for investigation here, and would suggest that some one try a low resistance transmitter of the Hunning type with, for instance, silver filings instead of granulated carbon for the variable resistance.

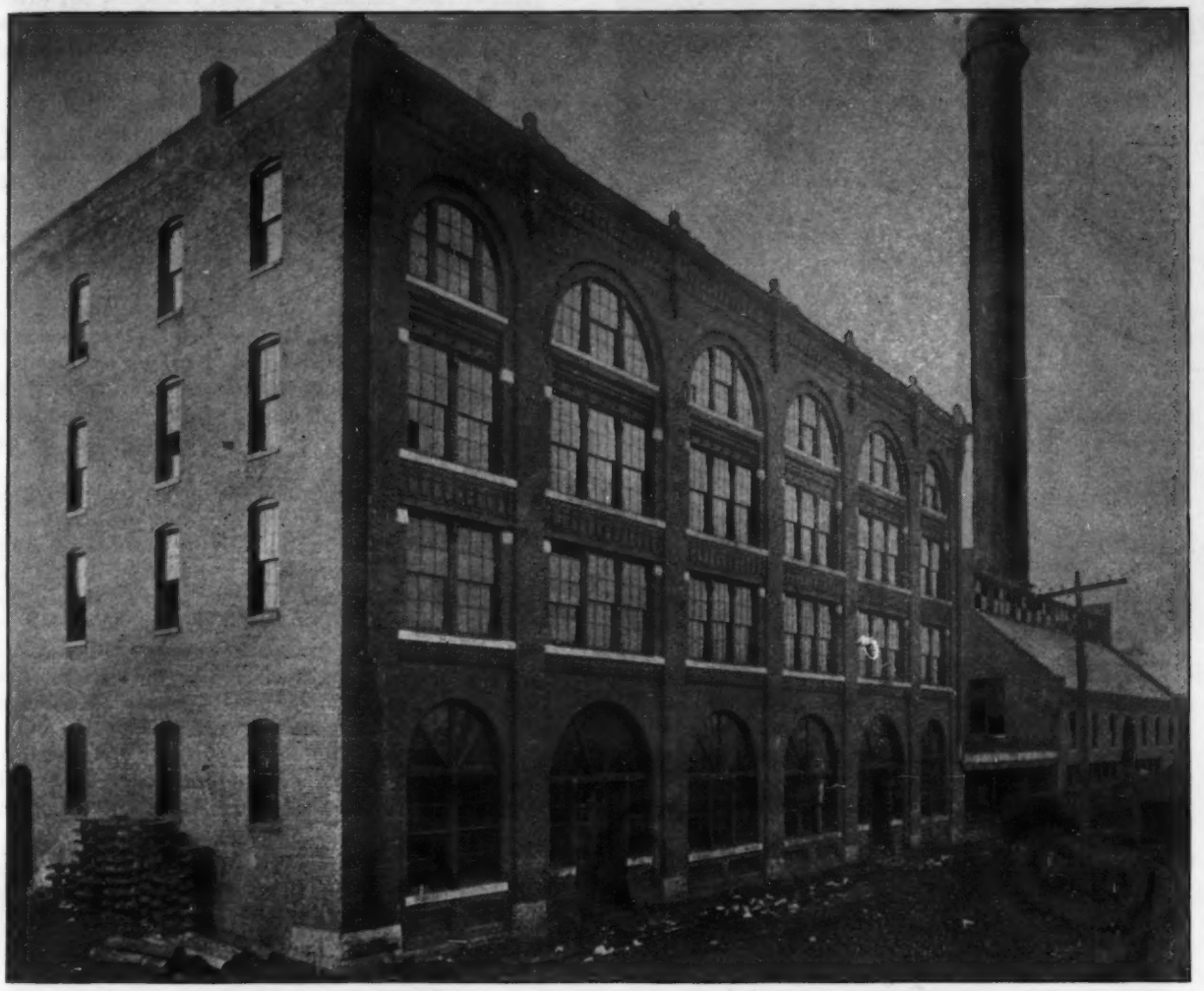
From the foregoing it would seem that even with the Berliner patent the monopoly of all essential devices for the transmission and reception of speech by electricity it no longer vested in the Bell company, and that the ironclad protection of the telephone industry by patents necessarily terminates on March 7.

Although this goes far toward making the long-looked-for "competition" a possibility, it is by no means the only factor to be reckoned with in considering the probabilities of a real and active competition in telephone exchange and long distance service.

## The Electrical Side of St. Louis.—IV.

### THE MUNICIPAL ARC LIGHT AND POWER COMPANY.

When his appointment had been made in 1889, Mr. Ayer, with characteristic energy, at once notified the various supply houses of his requirements, and the throngs of representatives of wire, pole, engine and general supply men that came to the Southern Hotel in May, 1889, may almost be compared with that other gathering of electrical men which is expected to convene in the same city on Feb. 28 and March 1 and 2 of this year. While they differed not in energy from those whom we expect to meet so soon, it may be said that they did not convene on such fraternal terms as are expected to predominate in the coming gathering; but each for himself endeavored to prove in convincing terms the superiority of his own goods, both as to quality and price, over those of his competitors.



EXTERIOR MUNICIPAL ELECTRIC LIGHTING AND POWER STATION.

Referring more particularly to the arc light plant, which we shall describe more in detail later, at the time of the contract even the ground for the building had not been procured. Immediately after the appointment of Mr. Ayer, a piece of ground had been secured extending west along the railway tracks between Eighteenth and Twenty-first streets and the Missouri Pacific tracks. While the location was good, the size was less than desired, though it seemed the only available space in that vicinity. The site selected was formerly an old stone quarry having a bank at one end which required blasting down, and a deep excavation at the other which required filling up; all of this preliminary work having to be done before the foundation could be started added materially to the difficulties which had to be overcome. In the filled portion the foundations were to be built on piles driven in regular rows through 20 feet of made ground to the solid rock. There were 800 of these, and resting upon them were cap timbers 12×12 inches, and the space between was filled with concrete, the whole covering to a depth of six inches the capping before referred to. On this concrete the brickwork was laid in cement, 1,200,000 brick being used for the foundations of the engines alone.

While the Municipal Arc Light and Power station, the one to which we have just been referring, is not the particular subject under discussion for this number, still it seems proper to give it some space at this time on account of the influence it has had on the development of the electric lighting industry in the city of St. Louis. Had this attempt, under exceedingly unfavorable circumstances, proved anything but the success that it has, St. Louis might not occupy to-day the position in the electrical world that is now so universally conceded to it.

Back of the mechanical difficulties of constructing the numerous lighting plants which were called for by these contracts, were others of a business and technical nature no less serious than the former, and which would have taxed the abilities of the best engineers in the world under circumstances less trying. The Municipal Arc Light and Power plant was not in reality an entirely new enterprise; it was rather a consolidation of several previously existing competing enterprises, each under a separate head, managed according to different ideas, sometimes duplicating the work of each other; and in no sense were they so arranged as to admit of ready amalgamation to work in harmony for a common purpose. It was under these circumstances that Mr. Ayer took hold; and the problem that he had before him was to harmonize all of these discordant elements, unite them together into a system as a whole and to bring them to a state of perfection which would enable his company to fulfill the contract they had undertaken, which, in those days, was at an exceedingly small figure, leaving a margin of profit so small that it was questioned at the time if it could possibly be accomplished without financial disaster to those who had undertaken it.

From such beginnings has been built the largest single arc light station in the world, and there will be no point in St. Louis of more general interest to the electric light man than this; nor could an assemblage be easily gathered in any part of the world that would be more fully appreciative of the engineering skill and business ability exemplified in this station, presided over by the worthy president of the National Electric Light Association.

The difficulties of getting together a plant of this magnitude, increased by those which have been briefly referred to, required the services not only of a thorough electrician, but also of a man of broad business capacity. In both of these directions Mr. Ayer has shown such ability that no words of praise can be so strong as the station itself. As the work progressed the difficulties became more and more apparent, and the work so arduous that the management desired to employ skilled assistants for Mr. Ayer, but the latter realized that to make a success the whole arrangement must be according to one definite plan, and that no compromise could be tolerated. For this reason, notwithstanding impaired health, due to overwork and anxiety, he declined the well-meant offer, and single-handed brought order out of chaos, and takes pride to-day in showing the result of his handiwork in decidedly the largest, one of the best equipped and best managed stations in the world.

The engine room on the ground floor, on a level with the railway tracks, is 105 feet long by 95 feet wide and 20 feet in height. It is provided with a concrete floor and here are located the seven engines which drive the whole plant. These are of the Hamilton-Corliss type, each of 640 h. p., there being also one of the same make of something over 50 h. p.

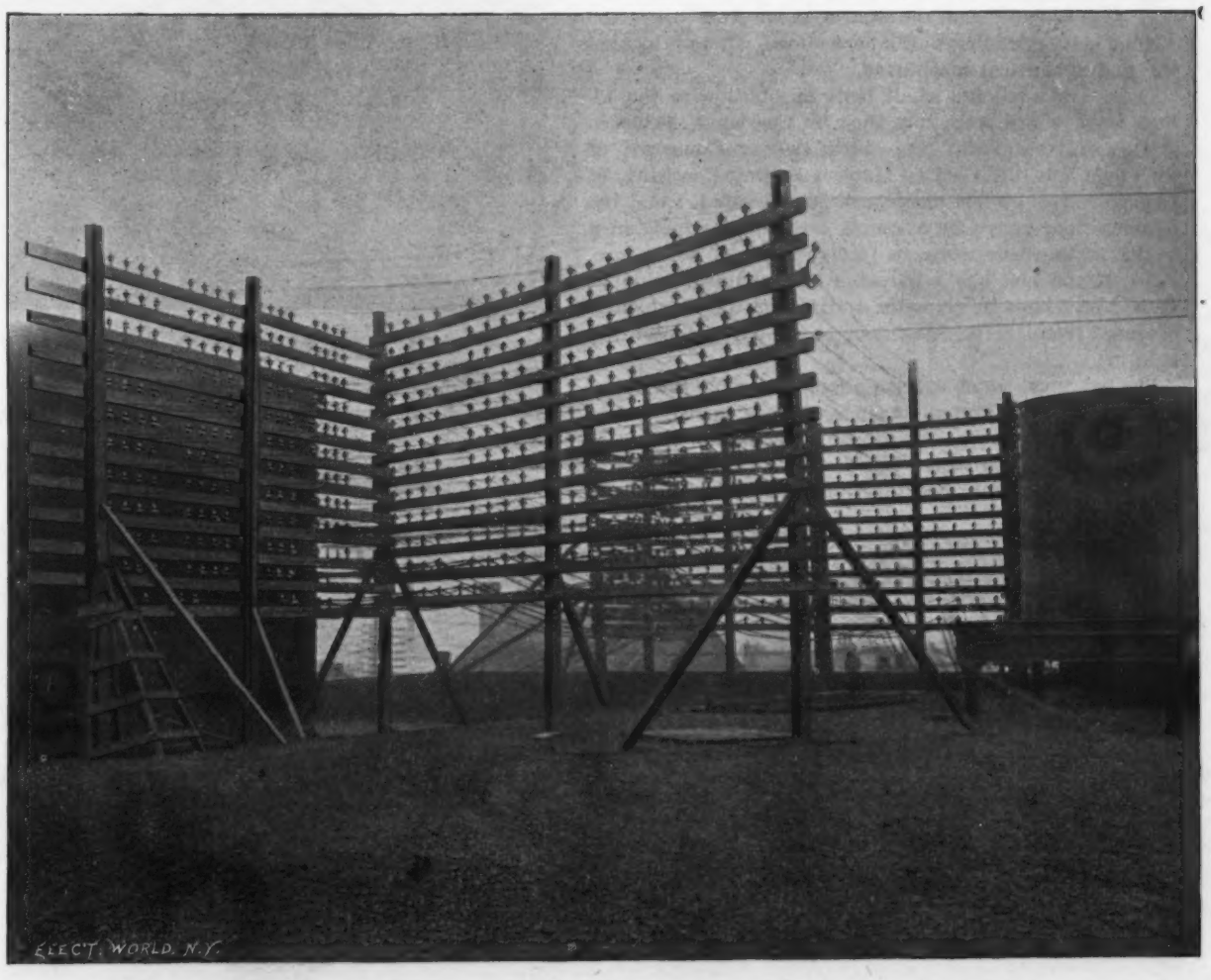
On this floor, also, was formerly located the 350-h. p. multipolar Thomson-Houston generator referred to in our description of the Benton & Bellefontaine Railway, as furnishing the power for that road before the installation of their present plant. There are also located on this same floor two Slattery alternators of 3,000 lights capacity each.

Underneath the engine room is a large oil cellar, in which the oils used are filtered upward through water, sand and charcoal. Galvanized iron-lined oil cabinets are distributed throughout the building, containing the oiling cans and the wiping towels, no "waste" being allowed about the place.

One of Mr. Ayer's hobbies, which one finds highly exemplified throughout the establishment, and which some other central station managers may do well to emulate, is cleanliness.

An illustration of this, calculated to excite the risibilities of the visitor, is encountered as one goes west from the engine room and enters the low-ceilinged room or gallery into which the coal is thrown from the tracks outside, and whence it is carried by means of tram cars and dumped into bins convenient to the boilers located still farther toward the west. As one enters the door into this coal room his eyes are greeted with the sign, "Wipe your feet."

The coal room just referred to is a low-ceilinged gallery, a tunnel, in fact, beneath the street, connecting the boiler house with the power house. Here also are placed the conduits which carry the steam from the boilers to the engine, there being three large pipes 24




WIRE RACKS ON ROOF.—MUNICIPAL ELECTRIC LIGHTING AND POWER STATION.

inches, 18 inches and 10 inches, respectively. The coal bins referred to are intended for the immediate supply of the boilers, but in addition to these other storage capacity has been provided capable of holding a reserve of thirteen car loads of coal as provision against irregularity of supplies from without. While this reserve capacity may appear large at first, it will be seen that it is really inadequate to supply a deficiency for more than

a very short time, since the daily consumption of fuel in the establishment approaches very closely to a hundred tons.

The boiler house proper, the floor of which is 32 feet

STORE ROOM AND REPAIR SHOP -MUNICIPAL ELECTRIC LIGHTING AND POWER STATION.

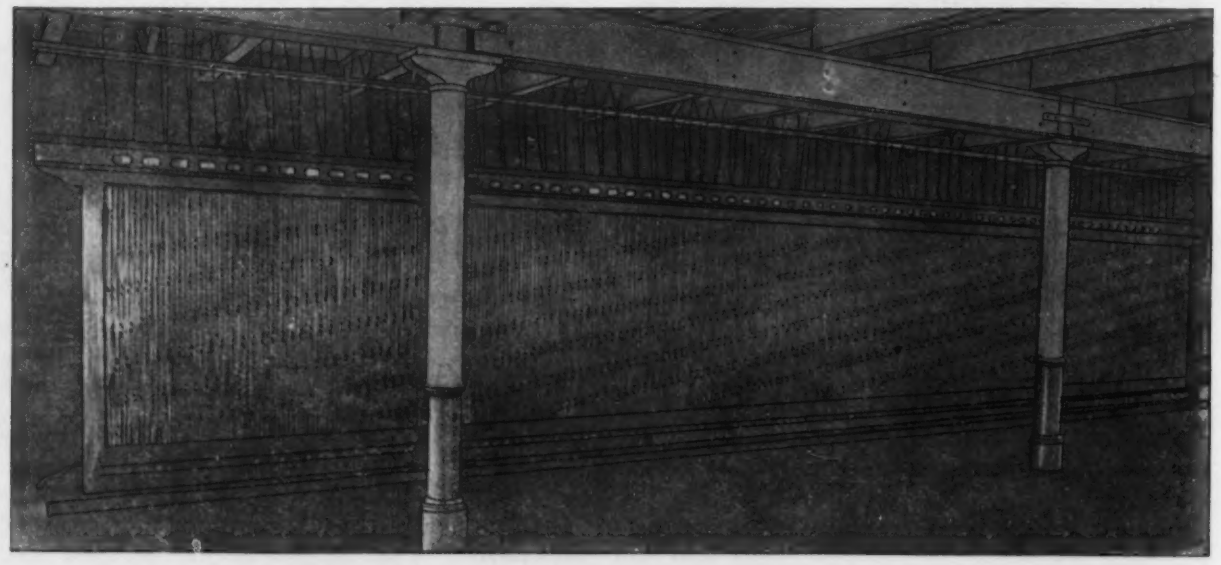
below the level of the street, is to the west of the gallery just described. Here are located 19 vertical boilers, each 12 feet in diameter and 35 feet high, extending to near the roof of the boiler house. Draft is furnished to these by a single stack 214 feet 4 inches high and 14 feet in diameter at the base. In the northwest corner of the boiler room is an ash elevator, operated by a 4-h. p. Baxter motor, by which all the ashes are elevated to a chute, through which they are delivered without further handling to cars stationed on a side track built for this purpose.

Returning again to the main building, and ascending one flight, we find the second floor equipped with 400 feet of 6 inch hammered iron shafting, divided into seven sections, which constitute four lines of shafting arranged parallel with each other, the several sections of each line being so connected by means of friction clutches of the Fall River Company's make as to enable them to be thrown in or out of action as desired.

Each shaft is driven by a 48-inch double leather belt, running over a steel-rimmed pulley 56 inches in diameter and 52-inch face, and the shafts themselves drive the 10-inch belting leading to the floor above, where is located the main electrical machinery.

There are some 120 small belts in addition to the 48-inch belts, which were furnished by Charles A. Schieren & Co., of New York; the Shultz Belting Company, of St. Louis, and the Charles Munson Belting Company, of Chicago. The clutch mechanism is operated from the dynamo floor above by a simple lever device lying in a cavity in the floor made to receive it when not in use. Each engine belt has a patented steel-rimmed tightener pulley, 36 inches in diameter and 52-inch face, which is operated from the shafting floor to tighten or loosen the belt.

The bearings, which are self-aligning, receive the necessary oil through a system of pipes which is carried thence by drain pipes to the oil filter in the basement, from which it is pumped to the fourth floor to be used again. All the transmitting machinery on this floor was made

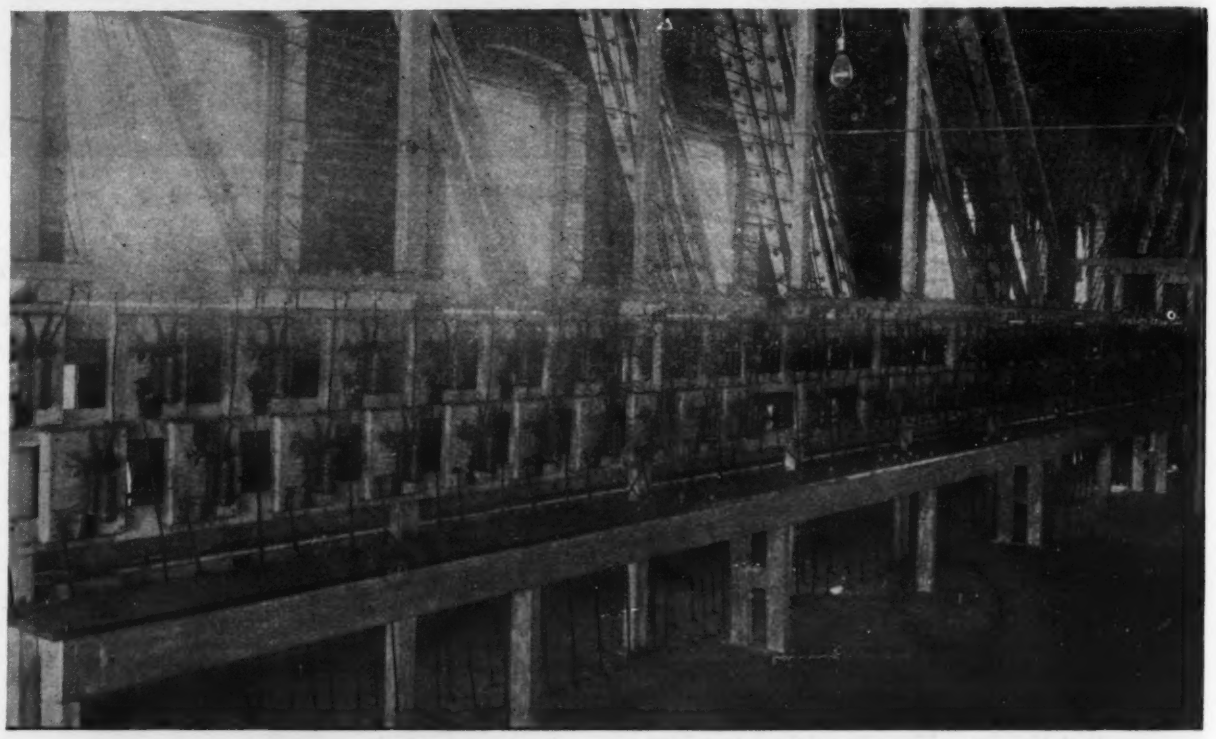


SWITCH BOARD.—MUNICIPAL ELECTRIC LIGHTING AND POWER STATION.

and set up by the Falls Rivet and Machine Company, of Cuyahoga Falls, O., and the best evidence of its satisfactory character is that while only one man is required to care for all of it during the operating hours, no mechanical defects sufficient to cause material loss of time have as yet developed.

Going west again and crossing the street (for now we are on a level with the latter) we enter the second floor of the boiler house. Here we find the Rohan exhaust steam heaters, six in number, and the purifiers and the Hall duplex pumps.

The dynamo room is on the third floor of the main building, directly over the shafting floor. Here will be met a sight that must rejoice the eyes of the central station man, for here, collected together on a single floor, is the largest collection of arc-lighting apparatus thus far installed in a single establishment.



LIGHTNING ARRESTERS.—MUNICIPAL ELECTRIC LIGHTING AND POWER STATION.

At a single sweep of the eye one may take in sixty-three 60-light arc machines, thirteen 80-light arc machines, two 75-light arc machines (all of which are of 2,000 c. p., except the two 75-lighters, which are of 1,200 c. p. each) and three alternating dynamos of 3,000 lights each. There are in all five alternating dynamos of the same capacity, but the other two have been referred to in our description of the engine room. All of the arc light machines except the 75-lighters are of the Wood type, and the alternating machines are of the Slattery design.

Each of these machines has near it a screw bar extending to the shafting floor beneath, by which the friction clutches are operated, rendering it possible without leaving this floor to throw in or out of action any one or more of the generating machines there located. But a description of this floor would be incomplete without mention of the immense switchboard, the design of Mr. Ayer himself, extending for 60 feet along the south wall. Of this he feels justly proud, and on account of some of its unique features and its simplicity it will doubtless attract the attention of visitors to the National Electric Light Convention.

It resembles in some respects the switchboard of a central telephone station, the connections being made between the various circuits and dynamos by means of flexibly connected plugs introduced into spring-jacks. By this means any circuit can be readily connected to any dynamo, and any two or more dynamos can be connected in series when desired. On this floor, too, is located a small lounging room for the convenience of employees—not that Mr. Ayer's employees are expected to lounge, or that they do, but for the purpose of affording them facilities for writing and reading during their moments of leisure, and for this purpose it has been equipped with tables and stationery, and has been provided with a few periodicals and works of reference.

With the enormous area covered by the circuits of this establishment, it will be evident that were not some system employed in reaching the various lamps in time of trouble and in trimming, the unnecessary time consumed in covering the ground over unnecessarily long routes would be a matter of vast importance. Mr. Ayer has provided for this by having constructed in miniature on the walls of this room a fac-simile of all the circuits, which gives the location of each lamp, and on which are also marked the routes which each trimmer must make in his daily rounds, and which also the "trouble" man must pursue in order to reach a given instrument in the shortest possible time.

These routes are, of course, the shortest that can be laid out, and Mr. Ayer estimates that the saving by this simple device has repaid many times the expense involved in its construction.

Ascending again another flight in this building, we come to the top floor. Here are located the converter or transformers for the alternating currents, at least such of them as are necessary for the local control of the currents, the meters, testing room, wire rack, carpenter shop, repair shop, the Thomson lightning arresters and the store room.

Two of these departments will deservedly attract especial attention. These are the wire racks and the store room. In the former the plan has been adopted of carrying the wires within the building in the same direction as that in which they approach the building from without.

As the wires enter the building, they are supported at frequent intervals on glass insulators, and are separated from each other by a uniform interval of seven inches and their relative positions are the same as they occupy on the poles outside, and they bear the same numbers, so that confusion as to where a given wire leads is removed. All of the wires enter the room from the racks on the roof, and proceed thence through the lightning arresters, which

are arranged in a row on the south wall, to the switchboard in the room below, where they are connected to their appropriate dynamos, as before described.

In the centre of this floor, wired off with heavy netting, is the supply room. But one person has a key to this, and all requisitions must be made through him, and the material given out is charged up to the person making the requisition. In case any of the material is returned, it goes through the same hands and proper credit is given. A report is made at the same time of the work done, which is afterward verified by an inspector, and thus track is kept of the disposition of all supplies given out and leaks are prevented.

Perhaps the most interesting feature of this store room is the lamp closet. This is a tall shaft, about 4 feet by 8 feet, and extending to near the ceiling, and is opened by means of sliding doors which form its two wider sides. Within are arranged fourteen shelves, which rest on cleats, enabling them to slide in either direction when the doors are open. Each of these shelves is pierced with 500 holes of 1⅛ inch diameter, and in these the lamps are placed, sockets down. In this way lamps of different sizes may be grouped by themselves, and all may be located and reached with little possibility of breakage. The plan followed here is exceedingly simple, and can be duplicated by any carpenter in a very short time. This particular rack, although it occupies a floor space of but 4×8 feet, has a capacity for 7,210 incandescent lamps—more, indeed, than is really necessary for even this large establishment to keep in stock.

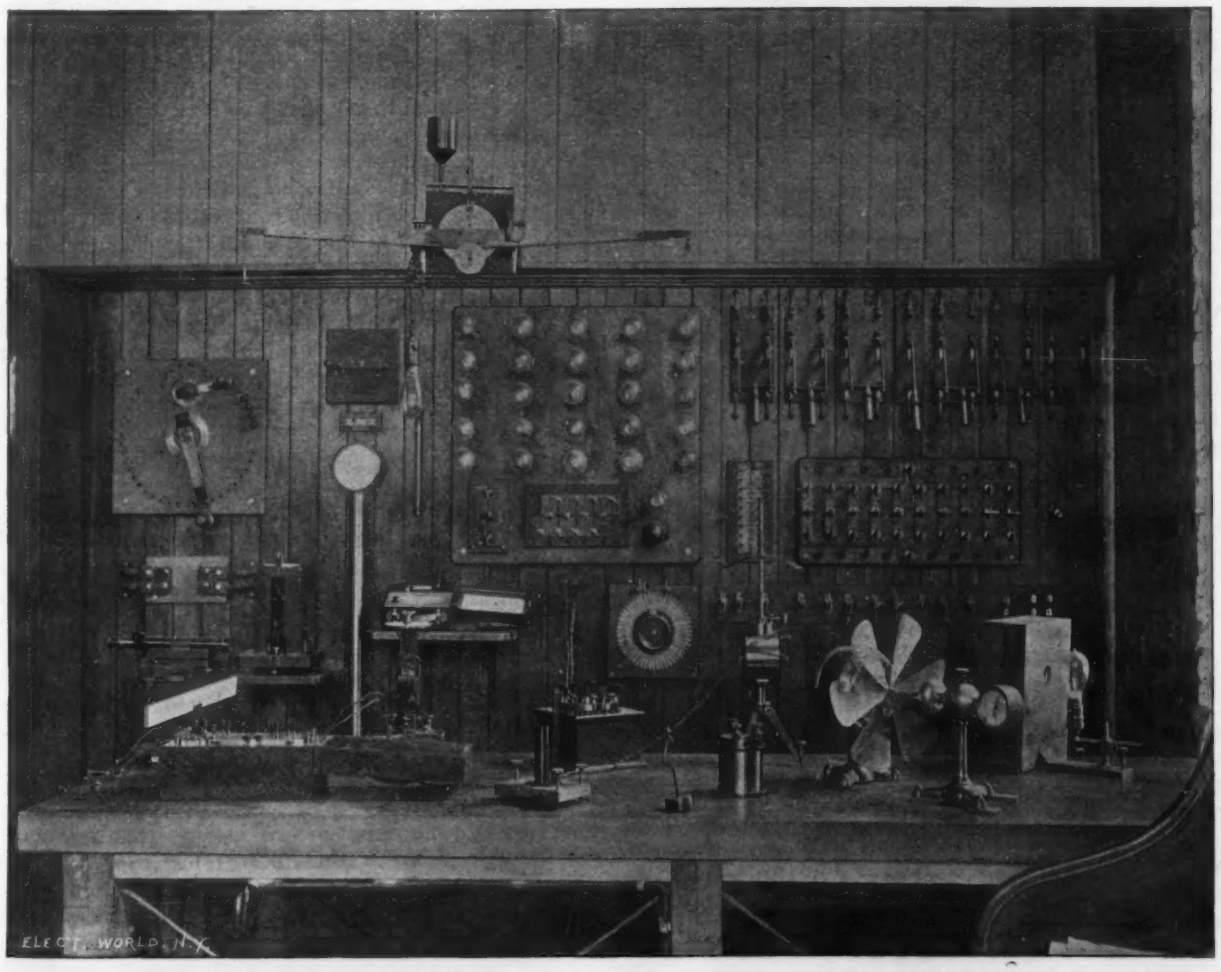
Until recently, although the name would imply that they had, the Municipal Arc Light and Power Company had no distinctively power circuits, except those referred to as supplying the Benton & Bellefontaine Electric Railway. They had, however, something of a power supply business, through their extensive arc light circuits, but somewhat recently they have gone extensively into this branch of the business, having equipped the building at 212 Gratiot street especially for this purpose. This was formerly known as the Heisler plant, and was employed as an adjunct to the main station to supply current over long distances for the incandescent lamp by means of the Heisler system. It has now, however, been entirely changed over to a power generating station, and is equipped as follows: Five horizontal tubular boilers of 80 h. p. each; three 14×20 Russell engines and one 12×14 Buckeye engine. These drive one 120-kilowatt 500-volt generator, one 80-kilowatt 500-volt generator, and one 30-kilowatt 500-volt generator.

miles of wire, of sizes ranging from No. 8 to No. 0000. These are wired to 20,000 16-c. p. lamps and cover an area of 30 square miles. One of these No. 0000 feeders extends 12 miles to Webster Grove (a suburban town), and lights up the principal suburban residence district.

The 500-volt motor circuits contain about 20 miles of wire of No. 0000, and have about 250 h. p. in motor capacity connected.

VIEW IN BOILER ROOM, MUNICIPAL ELECTRIC LIGHTING AND POWER STATION.

To attend to this large number of lamps, and to keep everything running smoothly, is a job of no mean size, as those who have had experience in similar undertakings well know; but it has been reduced to such a system by Mr. Ayer as to give little trouble and to be very effective. For this purpose there are provided 36 trimmers' carts and 9 others for the night and day inspectors and the



AN INTERIOR OF THE EMERSON ELECTRIC MANUFACTURING ESTABLISHMENT.

There are also established in this building one 3,000-light alternating dynamo and one 1,000-light alternating dynamo. These two latter machines are used as a reserve for the big plant.

Relative to circuits and lights wired, this company now has 36 city arc light circuits, measuring 532 miles, ranging from 8 to 22 miles each, and averaging 15 miles per circuit. These cover an area of 50 square miles, and are connected to 2,100 arc lamps. It has also 30 commercial arc light circuits, aggregating 240 miles of wire, and connected to 1,500 arc lamps, which cover the downtown district. Thus the arc light circuits aggregate 772 miles and supply current to 3,600 lamps.

The alternating incandescent circuits contain about 600 trouble men and meter inspectors, which are constantly in service. The trimmers' and trouble men's carts are two-wheeled vehicles, and each contains a kit of tools and all other material necessary for every emergency.

At night there are always two of the trouble carts hitched up and ready to start for the scene of trouble at a moment's notice. One of these is kept standing at the generating station and the other at the downtown office on Fourth street, near Washington avenue. Competent men are always in attendance at both places, and the moment word comes that there is trouble anywhere, or an alarm of fire is sounded, away go the carts as certainly as does the fire marshal or the fire engine in case of an alarm of fire. In fact, the Municipal Arc Light and Power Company maintains a force very similar to that of the fire marshal's office. Their duties are not to extinguish fires, however, but to assist the firemen by every means in their power by cutting wires which may be in the way of their work, as well as to rectify faults on the line. By this careful attention to the interests of the city, as well as their own, the company has won its way to popular favor; and it may be said of St. Louis alone, of all the large cities of the country, that one there hears no talk or clamor about the burial of wires, which has caused such an uproar elsewhere and such inconvenience and expense to the electric lighting interests.

Visitors to St. Louis may learn much from this fact, and may be brought to a realizing sense that those who have had trouble of this nature have themselves largely to blame, for the reason that the trouble they have encountered has been probably in a large measure due to a laxity of attention to their overhead construction, which permitted it to become a public nuisance.

In St. Louis the wires are entirely overhead, and, although there exists a subway company, known as the St. Louis Subway Company, there is no underground construction for the use of electrical conductors except about a mile and a half of conduit laid by that company for the purpose of preserving its franchise.

A writer in The Electrical World over two years ago, in speaking of the management of this establishment, had this to say: "Mr. Ayer's systematic method of keeping track of all the minute details that enter into the operation and maintenance of a plant of this magnitude is worthy of more than passing notice, for there are many points that could well be tested in some of the smaller plants that have proved hardly self-sustaining simply through an absence of all watchfulness over the minutiae from the lack of which spring the small leaks that increase in volume so rapidly." What was said then remains true to-day, after an added experience of more than two years, which has only served to emphasize the points so apparent at that time.

The officers of this company are: R. T. McDonald, president; J. G. Kelly, secretary and treasurer; James I. Ayer, general manager.

### The Emerson Electric Manufacturing Company.

The Emerson Electric Manufacturing Company was organized in the year 1890 with J. W. Emerson, president; R. W. Meston, superintendent, and C. R. Meston, secretary, with a full paid capital stock of $50,000. It was the intention of the company to manufacture a line of electrical specialties, each of which should have some point of special excellence or novelty, and this policy has been strictly adhered to, and has built up for them a trade which is already phenomenal for so young a concern. The energies of the company were at once devoted to the production of a successful alternating current motor for fan purposes, a problem until then unsolved, and during the season of 1891 they brought out the first model of the Meston alternating current motor, which is to-day so favorably and universally known to users and dealers throughout this and other countries.

The rapidly increasing business of the company soon necessitated the enlarging of their factory, and a temporary factory had to be put in operation, in addition to the original plant, to fill the orders for motors and other specialties. In the autumn of 1891 their still increasing business forced them to seek new and larger

quarters, at the present location, Nos. 1108, 1110 and 1112 St. Charles street, where they have a large and convenient three story factory, with every convenience for the economical manufacture of electrical goods. During the past year they have more than doubled their equipment, the demand last season for the 1892 model of the Meston fan motor being unprecedented.

On the first floor are the general offices of the company and the private offices of the president and superintendent, including the private testing room and draughting rooms. On the same floor is also situated the store room, where materials and supplies are kept and recorded by a strict system, so that the exact condition of the stock is known at all times. Next to the store room comes the heavy presses and machinery used in the manufacture of motors and other articles. A great number of special and elaborate dies are used here in the different processes which enables the turning out of accurate and exact work at amazingly low cost.

The second floor comprises the general machine shop for light work and the polishing and lacquering departments.

The third floor is taken up by the pattern shop and fan sembling room, and also the testing room for fan motors.

In January, 1892, the capital stock of the company was increased, and J. W. Emerson retired from the presidency of the company, his place being filled by the election of Mr. H. L. Parker.

The engraving shows the switchboard in the private testing room of the company. Every facility for all kinds of electrical and power testing is here at hand. Direct currents from 100 volts up to 500 volts are available at all times. Alternating currents are supplied by a special converter at any E. M. F. desired, from one volt up to 2,000 volts. One thousand amperes of current at a pressure of about three volts can be supplied by this converter by means of a special coil.

The current from any of these circuits can be led off to the measuring instruments by means of the change board at the right. The lamp board is arranged so that any combination of lamps in series or multiple can be made by changing the contact screws of the switchboard underneath. The change board, in the form of a letter E on the lamp board, is for the purpose of cutting in either the coarse or fine wire of the dynamometer, seen on the shelf to the left, without changing the terminal wires.

At the upper left hand corner are seen the regulating switches of the special converter before mentioned. To the right of the lamp board is the terminal board of a large testing battery, which can be placed in any combination by means of the contact plugs shown. At the upper righthand corner may be seen the switches connecting with the various sources of current, and at the lower corresponding corner are the various terminals or binding posts therefor.

In front of the switchboard is a massive testing table, on which are made all insulation and resistance measurements. This table is rigidly braced, and is set upon six piles driven into the ground, and is in no way connected with the building. In this way all vibration is avoided.

Suspended from the ceiling may be seen a special form of Prony brake, for testing the power of small motors. A feature of this brake, which is absolutely necessary for small power, is that it is so delicately counterbalanced by means of weights that when the clamp is loosened there is absolutely no friction on the pulley, the brake being suspended in midair as it were. Very satisfactory results are obtained by this means.

This company makes a practice of testing thoroughly under actual conditions every piece of apparatus before leaving the factory.

## The St. Louis Convention.

The following is a complete list of those who have taken passage on the Electrical Special:

New York.—George J. Jackson, Herbert Laws Webb, H. M. Swetland, A. B. Laurence, W. J. Johnston, Augustus Noll, C. W. Price, R. B. Corey, H. C. Adams, E. E. Wood, P. C. Ackerman, B. R. Western, Nelson W. Perry, Fremont Wilson, John A. Seely, C. O. Baker, E. W. Seymour, F. A. Magee, W. S. Key, J. C. Pierrez, B. E. Greene, F. M. Pierce, W. F. Osborne, H. M. Haines, Nikola Tesla, Geo. M. Phelps, T. C. Martin, F. R. Colvin, H. C. Myers, Wm. J. Hammer.

Philadelphia.—A. H. Manwaring, Mrs. Manwaring, James A. Pentz, T. Carpenter Smith, A. J. De Camp, Mrs. De Camp, Miss De Camp, Miss Cumming, A. J. Martin.

Pittsburgh, Pa.—E. H. Heinrich, M. Coster.

Brooklyn, N. Y.—E. F. Peck, James Ferjuson, T. E. Crossman.

Bridgeport, Conn.—C. E. Carpenter, W. C. Bryant.

Newark, N. J.—R. O. Heinrich, C. McIntire, Wilson S. Howell.

Boston, Mass.—Dr. Louis Bell.

Warren, O.—W. D. Packard.

Troy, N. Y.—E. G. Bernard.

Washington, D. C.—F. W. Royce.

Sewickley, Pa.—E. P. Young.

Syracuse, N. Y.—W. J. Morrison.

London, Eng.—Prof. Geo. Forbes.

Brunswick, N. J.—A. J. Jones.

Cleveland, O.—E. P. Roberts, Fred. A. Scheffler.

Windsor, Conn.—A. D. Newton, M. E. Baird.

Hartford, Conn.—C. E. Newton.

We reproduce herewith the programme:

PROGRAMME ST. LOUIS CONVENTION.

Tuesday, Feb. 28, 1893.

Meeting of the Executive Committee at 9 A. M., parlor of Southern Hotel.

Morning Session, 10:30 o'clock, at Bell Telephone Building.

Address of Welcome, Hon. E. A. Noonan, Mayor of St. Louis.

Address, Pres. James I. Ayer.

Report, Committee of Data.

Afternoon Session, 2 o'clock.

Report, Committee on Safe Wiring.

Report, Committee on World's Columbian Fair.

Paper, A. D. Adams, Wrought vs. Cast Iron for Field Magnet Frames.

Wednesday, March 1.

Morning Session, 10 o'clock.

Paper, Prof. George Forbes, Thermal Storage for Central Stations.

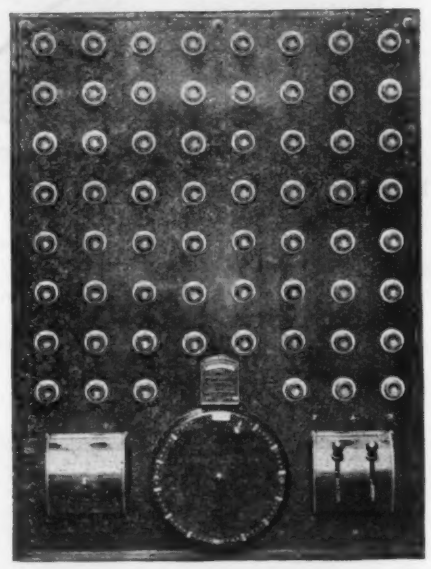
Paper, Charles S. Bradley, Long Distance Transmission of Power.

Paper, L. B. Stillwell, Under What Conditions is the Use of Water Power Economical?

Afternoon Session, 2:30 o'clock.

Paper, E. A. Armstrong, Morals of Corporations.

Paper, R. H. Sterling, Some Experiences with the Alternating System.



The Manwaring Indicator and Testing Board.

Paper, William Brophy, Relation of Insurance to Electric Lighting and Power.

Evening Session, 8 o'clock.

Lecture, Nikola Tesla.

Thursday, March 2.

Morning Session, 10 o'clock.

Paper, W. H. Browne, Underground Conduits and Conductors.

Paper, Calvert Townley, The Incandescent Lamp from a Commercial Standpoint.

Paper, Dr. Louis Bell, Power Transmission for Central Stations.

Afternoon Session, 2:30 o'clock.

Paper, H. C. Myers, Preservation of Poles and Cross Arms.

Executive Session.

Reports, Secretary and Treasurer, Election of Officers.

NOTES.

J. F. Cummings, of Cummings & McCoy, has returned from Chicago, where he has been exhibiting their new underground conduit system, and will return to St. Louis to attend the National Electric Light Convention.

F. B. Rae, the electrical engineer, will attend the St. Louis convention in the interests of his business.

George E. Fisher, of the Commercial Electrical Company, of Detroit, will be found at the St. Louis convention representing his firm.

## Testing Arc Circuits.

BY A. H. MANWARING.

The following device, for locating faults, such as leaks, grounds, crosses, etc., and for determining the number of lamps burning on a circuit, may be of interest to central station managers. It consists of a series of resistances, as, for instance, a bank of sixty incandescent lamps of high voltage, and a switch arranged to cut out of circuit one incandescent lamp after the other, a double contact grounding switch, an automatic switch to protect the incandescent lamps from accidental swinging grounds, etc., and a special indicator to determine the number of lamps desired.

In making a test, the first operation is to determine how many arc lamps are burning on the circuit. This is done by connecting the two flexible cables (that are attached to the test board) one to the positive and one to the negative side of the circuit to be tested. This connects all the sixty incandescent lamps in series as a shunt to the main or arc circuit; then the incandescent lamps are cut out of circuit, one by one, with the centre switch shown in the cut, until the indicator needle reaches the standard mark on the scale. The number of incandescent lamps remaining in circuit is equivalent to the number of arc lamps burning on the main circuit. After having determined the number of lamps burning, the operator moves the grounding switch—marked P—which disconnects the negative side of the test board from the main circuit and connects it to ground. The test is then made the same as before, by cutting out the incandescent lamps, and if a ground exists the indicator needle is brought up to the standard mark on the scale, and the number of incandescent lamps remaining in circuit is equivalent to the number of arc lamps on the positive wire between the dynamo and the ground.

To determine the number of arc lamps on the negative side of the main circuit between the dynamo and the ground, the operator reverses the grounding switch and repeats the test. If the number of lamps on the positive side and those on the negative side to ground do not equal the number of lamps indicated on the first test, the ground is not a perfect one, but offers a resistance, and the difference should be added equal to the number of lamps on each side, to locate the ground accurately. Thus, if he gets 40 lamps across on first test, 20 lamps P. second test, and only 10 lamps N. on third test, he adds 5 to each the positive and negative sides, locating the ground between the 25th and 26th lamps on the positive side of the circuit. A ground on underground cable is located in the same way as on an air line, between two lamps.

A swinging ground is located by cutting out of circuit only a few of the incandescent lamps at a time, and watching the deflection of the needle when the ground swings on, continuing to cut out the incandescent lamps until the swing of the needle reaches the standard mark on the scale.

To locate a cross between two different circuits, first see that both circuits are free from a ground connection; then substitute a ground on one, and measure the other circuit, and the cross can be located. If a ground should exist on one circuit, it is not necessary to add another.

If in making a ground test where two or more circuits are run on the same dynamo and the needle of the indicator is deflected in the opposite direction from other tests, it denotes that the circuit under test is clear, and that one of the other circuits is grounded; or if the number of lamps on ground tests exceeds those across the circuit on first test, it indicates that the ground is on one of the other circuits.

To determine if the current is reversed in a circuit, connect the flexible cables to the circuits marked, P to P and N to N. The needle should be deflected to the right if the current in the circuit is traveling in the proper direction, but if it is diverted to the left it denotes that the current is reversed.

A high voltage lamp is prepared so that the carbon only becomes red, thus making the test-board a high resistance through which it is perfectly safe to ground a circuit. By this arrangement only one-fifth of an ampere is shunted to ground when testing a grounded circuit.

This device, it is found, saves a great amount of time in locating trouble, and a man can be sent direct from the station to repair the same; it also lessens the danger from accidents and fires caused by unknown grounded circuits, as circuits can be tested as often as desired and trouble removed in a short time. This testing device is already in use in several central stations.

## The Charitable Critic and the Efficient Editor.

This conversation was overheard on Broadway last week after The Electrical World of Feb. 25 had come out:

"Going to the St. Louis convention?"

"No, sir, I am not. Are you?"

"No, indeed, not this time."

"Nice position you have got me into, by the way, through your lack of electrical information."

"Come, come, none of that! Just think of the ridiculous situation in which you have placed me by your assumption of superior electrical knowledge."

"I can't see it in that light. I always thought that editors were familiar with the subjects of which their papers treated, and that if correspondents made mistakes they would point them out to them and not advertise their ignorance to the world by printing articles that ought not to see the light. Apparently some editors are like the political refugee, who, traveling as a pretended professor of deportment, etiquette and dancing, was asked to give an exhibition of his dancing, and replied: 'Oh! professors don't do things—they only profess.'"

"Well, but see how much information you have obtained through the publication of your letter."

"So far as I am concerned, I would have preferred to remain in the densest and darkest ignorance on this particular point until my dying day rather than get the information in the way I did."

## Friends Whom We All Know.

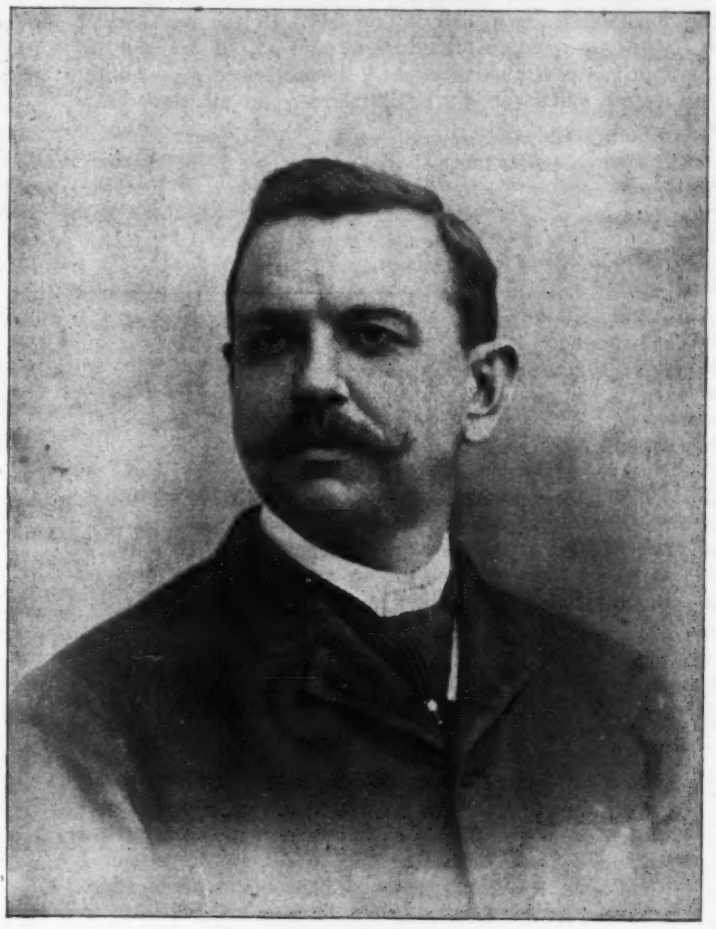
The central figures at a convention of the National Electric Light Association are the president, the secretary and the master of transportation. Usually, as in the present instance, these offices are filled by those whose careers are so well known among the electrical fraternity that a review of their histories as a means of introduction is entirely superfluous. However, with their portraits before us, it may be well, while we refresh our eyes, at the same time to refresh our memories by brief references to the salient points in the lives of these gentlemen who need no introduction, but to whom all visitors to the present convention will owe so much.

MR. JAMES I. AYER.

Mr. James I. Ayer, of whom we have already spoken elsewhere in this issue, and whose name is so intimately associated with the electric light interests of St. Louis, was born at New Bedford, Mass., in 1854. He was graduated as a civil engineer, and, after years of railway service, entered mercantile life. Upon the organization of the Jenney Electric Company, of Indianapolis, he became connected with the electrical business by identifying himself in 1885 with that company, and at that time commenced a career as an electric lighting engineer which has been equaled by few and surpassed by none. With indomitable energy and a clear head, this gentleman has marked his pathway by a series of monuments of successful practice, over the latest of which he still presides, and which will form one of the chief points of interest to the central station men who gather at this time at the St. Louis convention.

On June 21, 1889, Mr. Ayer was appointed general superintendent of the Municipal Electric Lighting and Power Company, which he has so successfully managed to the present day. Notwithstanding his arduous duties in connection with this establishment, he has found time at intervals to advise in regard to other electrical enterprises, the managers of which are too glad to avail themselves of such services. One of the most important of these instances, which has already been mentioned, was the planning and construction of the electrical power plant of the Benton & Bellefontaine Street Railway, of St. Louis.

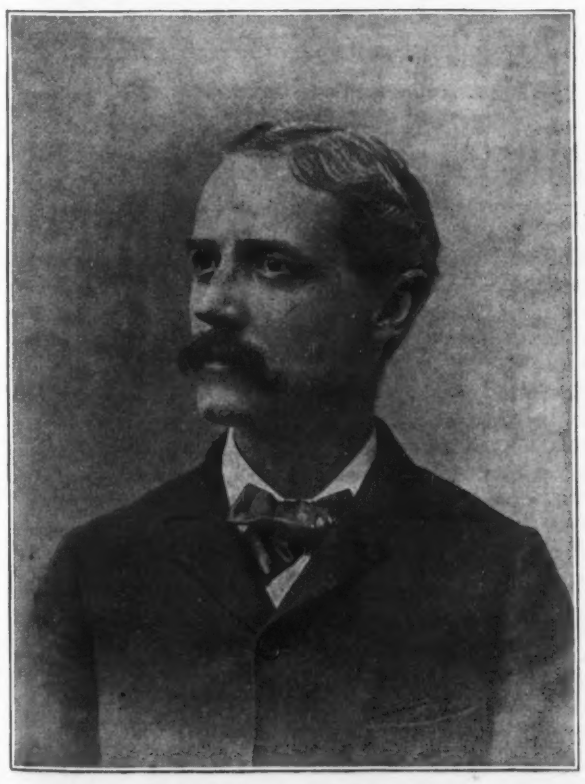
On Feb. 25, 1892, the National Electric Light Association honored itself by honoring him with a unanimous election to the president's chair, succeeding Mr. C. R. Huntley. Previous to this, however, he had been elected as first vice-president at the Providence meeting, but his greatest honor is that of having planned and constructed, and having placed in successful operation within eleven months from the day he took hold of the work, the largest arc lighting plant in the world.



MR. JAMES I. AYER,
PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

MR. GEORGE F. PORTER.

Mr. George F. Porter, the genial secretary of the association, with whom every member comes more or less intimately in contact, and who is known only to be liked, was born on March 12, 1855, in Pittsburgh, Pa., and was graduated from the public schools of that city in 1871. Beginning life as a civil and mechanical engineer, he continued that profession until 1873, abandoning it then for the iron business, which he followed up to the fall of 1875. During this year he first turned his attention to electrical work, commencing in this business as a telegraph operator. Until 1877 he was connected with the Pullman Palace Car Company, having his offices at Philadelphia. From this line of work he again entered the iron business, with which he was identified, with the exception of about one year, until 1883, during which he was connected with the engineering department of the Pittsburgh & Western Railroad. Later he went into the carbon business, and at another time held a position with the Westinghouse Electric Company in their Philadelphia office. During Mr. Huntley's term as president of the National Association, he was appointed to the position of secretary, in which he has given such universal satisfaction that he was reappointed by the present incumbent.



MR. GEORGE F. PORTER,
SECRETARY OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. Porter is personally exceedingly popular among the members, and, notwithstanding the arduous duties he is called upon to perform, both preceding and during an electric light convention, he always has time for a pleasant word and a hearty greeting for those who flock to his office as the fountain-head of all information in regard to those important events. He seems to possess in a remarkable degree the valuable faculty of recalling names and faces, and it is seldom that an active member of the association visits his office that he is not addressed at once by his proper name. As a manager and arranger of details, in both of which capacities he is called upon to serve, he has proved his ability on more occasions than one, and to him was attributable much of the success of the Buffalo convention, and much of that of the coming gathering will also be due to him.

MR. C. O. BAKER, JR.

Mr. C. O. Baker, the master of transportation, is a modest man and succeeds in keeping his personality in the background, but where one's works speak so loudly as do Mr. Baker's, it is impossible to hide their author.

Mr. Baker was born on the 12th of October, in 1857, in Newark, N. J. For many years past he has been connected with the firm of Baker & Co., of Newark, who are the only refiners of crude platinum on this continent, and who, with Johnson, Mathey & Co., of England, are known the world over as the principal workers in this refractory metal. While their work is not strictly electrical it is probably more intimately connected with the electric lighting industry than that of any other outside manufacturing industry; but Mr. Baker is personally interested in the lighting business much more intimately than the refining of platinum would seem to imply, for besides being interested in a number of electrical patents of various kinds he is also vice-president of the Newtown Electric Light and Power Company, of Newtown, L. I., of which Mr. Porter is secretary and treasurer. The firm of Baker & Co., whose works are at Newark, besides being the only refiners of crude platinum in this hemisphere, are also conceded to be the highest authorities in this country on the technics of that metal.

At the Baltimore meeting in February, 1886, the third of the conventions of this association, a transportation committee was appointed to prepare the way for the carriage of members to the fourth convention, to be held at Detroit in August and September of that same year. This was the beginning of the department now known as the Transportation Department, over which Mr. Baker has so long and efficiently presided. This committee were unable to accomplish anything, however, for the reasons that rates and concessions from the railroads were unattainable at that time. The first convention excursion in the history of the association was one to the Detroit convention, which carried but 20 people. During the Philadelphia convention, of February, 1887, the second excursion was made, the occasion of this being an invitation to the members of the association from the New York Electric Club to dine with them in New York at the Hotel Dam. For this a special train was obtained, which carried 42 members from Philadelphia to New York.

At the Boston convention, in August of 1887, no excursion was planned. At the Pittsburgh convention, in February of 1888, Messrs. Porter and Baker, on their own responsibility, hired two sleepers for the exclusive accommodation of the members. These were attached to one of the regular trains, and 63 people were supplied with berths, the overflow being accommodated in the regular sleepers.

At the Chicago convention, in February, 1889, the first special train in the history of the association was arranged for by Mr. Baker. This carried 85 members. The next meeting, at Niagara, in August of that year, was reached by a special from New York, which was arranged for by Mr. A. Z. Garratt, Mr. Baker being absent from the country at the time. The special to the Kansas City convention, in February of 1890, which was arranged for by Mr. Baker, was the finest special train that had ever been prepared up to this date. At Chicago it took on three cars in addition to the eight which left New York, and, with two diners and two locomotive, it proceeded to Kansas City, carrying 90 passengers in all.

For the Cape May and Providence conventions, which were the 12th and 13th in the order of their occurrence, no special trains were made up. Visitors to the Montreal convention, in September of 1891, were carried on a special train provided by the New York Central and Vermont Central railroads with the best service of the Wagner company. On this train were carried 125 people. A special train was also provided for the Buffalo convention, in February of last year, and this carried into the city of Buffalo some 139 or 140 members. Both of these latter excursion trains were arranged for by Mr. Baker, and in each of which he succeeded in eclipsing his previous successes.

With this record of his own making before him, Mr. Baker has felt that nothing would do for the St. Louis convention that did not surpass in every particular all previous efforts. As many of the visitors will peruse these lines for the first time while seated in the comfortable Pullman cars of the St. Louis special we feel that any attempt to describe the same would at this time be superfluous. But all will agree with the prospects held out that the St. Louis Electrical Special on the Pennsylvania Railroad is a fitting climax to the long series of brilliant achievements for which the National Electric Light Association is indebted to Mr. C. O. Baker as master of transportation. It is believed at the present writing that this magnificent train will go into St. Louis with from 125 to 150 pasengers, some 50 of whom will join it at New York and the remainder will be added at Philadelphia, Harrisburg, Pittsburgh and Indianapolis.

MR. CYRUS O. BAKER, JR.,
MASTER OF TRANSPORTATION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

## Electrical Oscillations of High Frequency.—III.

BY ERVIN S. FERRY.

### THE ENERGY OF THE FIELD PRODUCED BY THE EXCITER.

Dr. Oliver J. Lodge* by employing an exciter formed of two thin plates, each 120 centimetres square, placed 460 centimetres apart, charged by a powerful induction coil, obtained a field of force so intense that sparks could be obtained from any water or gas pipes in the building by simply holding a metallic point close to them. The wave length of these oscillations was 29 metres, the rate of vibration 10,000,000 per second, and power of initial radiation 128 h. p. At this rate the total energy would be dissipated in three vibrations. The equation by which this value of the radiation activity is derived was obtained by Lodge from a formula given by Hertz.† and it shows the surprising fact that "all exciters, large and small, started at the same potential, radiate energy at approximately the same rate; short, stout ones a little the fastest." There is a practical advantage, however, in using fairly large exciters, because then the oscillations need not be started with such extraordinary suddenness, and also because the vibrations do not die out as suddenly as in the case of small ones.

An exciter formed of two circular plates eight centimetres in diameter, each mounted on a rod six centimetres long and one centimetre diameter, separated from each other by a spark gap of eight millimetres, will produce an oscillation with a wave length of about one metre and the same initial energy of radiation as the large exciter; but at this rate the entire energy of 128 h. p. would be dissipated in the two-hundred-millionth of a second. We can thus see that even with this great energy it would be difficult to perceive on account of its exceedingly short duration. To produce continous radiation would require, according to this computation, 128 h. p.

### EXPLORATION OF THE FIELD PRODUCED BY THE EXCITER.

It is well known that the field of force surrounding a conductor carrying an alternating or pulsating charge is made up of two components: One, an electrostatic,

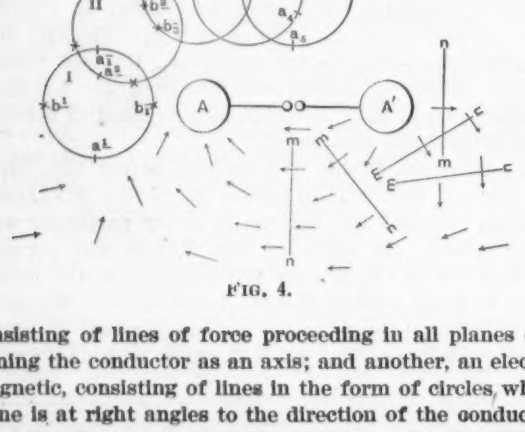



FIG. 4.

consisting of lines of force proceeding in all planes containing the conductor as an axis; and another, an electromagnetic, consisting of lines in the form of circles, whose plane is at right angles to the direction of the conductor. The direction of these components can be determined experimentally by the use of a resonator. In this par ticular experiment, Hertz used one of circular form which on account of its symmetry was easier to manipulate. First, the field in the horizontal plane was explored by holding the resonator vertically at such a height that its centre and the axis of the exciter were in the same horizontal plane, and then noting the spark length for different positions of the resonator. By this method the following results were determined for the electrostatic component:

(1.) If the vertical resonator be turned about its axis so that the diameter passing through the spark gap (which we will call the diameter of symmetry) describes a complete circle, the sparks will vary in length. Their maximum length is at the two positions when the diameter of symmetry is vertical; and the minimum, when the diameter of symmetry is horizontal.

(2.) The spark length in the vertical resonator also depends upon the angle between the plane of the resonator and the axis of the exciter. There are two maxima 180 degrees apart, and two minima each half way between the maxima. The direction of the lines of force will naturally be at right angles to the positions of the resonator when the action is at a minimum value. A few of these positions, as plotted by Hertz, are shown in the lower part of Fig. 4. A A′ is the exciter; the lines m n the projections in the horizontal plane of the resonator when the sparks are minimum. The arrows at right angles to these represent the direction of the lines of force. In any other plane than the horizontal the same results would be obtained if the resonator be kept perpendicular to the plane containing its centre and the axis of the exciter.

The exploration of the field produced by the electromagnetic component is effected by placing the plane of the resonator in the horizontal plane containing the exciter. The results thus obtained can be best studied by reference to the diagram: $a_1$, $a_2$, $a_3$, $a^1$, $a^2$, $a^3$, etc., represent the positions of the spark gap when maximum sparking occurs; $b_1$, $b_2$, $b_3$, $b^1$, $b^2$, $b^3$, etc., the positions of minimum sparking. In position I the points of maximum and minimum effect are equally distant from each other. There are two equal maxima, at the points $a_1$, and $a^1$ of spark length 2.5 millimetres. At the position II the resonator begins to be in the region of the electromagnetic lines of force, and so we have two unequal maxima, $a_2$ and $a^2$, 180 degrees apart, and two minima, $b_2$ and $b^2$, near the smaller maximum. The maximum sparking distances at $a_2$ and $a^2$ are 3.5 and 2 millimetres respectively. In the position III we have one strongly defined maximum $a_3$ of 4 millimetres. In the position IV there are again two maxima, $a_4$ and $a^4$, of 5.5 and 1.5 millimetres respectively. At V the maximum, $a_5$, is 6 millimetres, and at $a^5$ is 2.5 millimetres. In all these cases

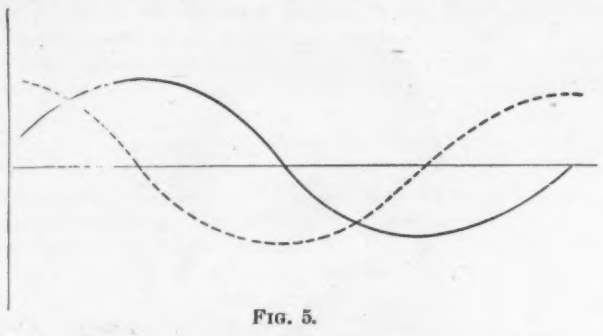


FIG. 5.

the diameter joining the maxima is at right angles to the resultant E. M. F. In none of these positions, however, is the sparking entirely independent of the electrostatic field except when the air gap is half way between the maximum and minimum positions.

### REFLECTION OF ELECTRICAL WAVES IN THE AIR.—INTERFERENCE.

By means of the resonator it has been shown that the electrical oscillations can be reflected from the surface of conducting bodies according to the same laws that govern sound and light. If a large metallic mirror, not smaller in any direction than the wave length to be reflected,* be set up in front of the exciter so that the electrical wave reaches it normally, the wave will be reflected back upon itself and nodes produced similar to those produced in the same way by sound and light.

When the resonator is placed vertically, normal to the horizontal plane containing the exciter, so as to obtain the maximum effect of the electrostatic component, it is found that the spark length varies when the resonator is moved away from the mirror toward the exciter. At certain well-defined points equally distant from each other, there is a minimum action, while from these nodes the action gradually increases to maximum values and then decreases to the succeeding node. Hertz represents this distribution of energy by a curve like the heavy one in Fig. 5.

If the mirror is a good conductor and well grounded, there will be a node at the surface a little behind it.

By moving the resonator, placed horizontally, back and forth in the horizontal plane passing through the exciter, the values for the other curve, Fig. 5, were obtained. After the third half wave length the nodes are not distinguishable. On the assumption that the sparking distance is proportional to the maximum total amplitude of the wave, this curve shows the distribution of energy in the elctromagnetic component. This pair of curves show that the electrostatic component is a quarter wave length in advance of the electromagnetic, which also is according to theory.

The curves in Fig. 5 seem to show that the wave of electric induction approaches a true sine curve, but measurements made since those of Hertz make it appear that although it may begin as a harmonic curve its logarithmic decrement is very rapid, and that the real form is more like that of Fig. 6. In this curve the wave length remains constant while the amplitude decreases

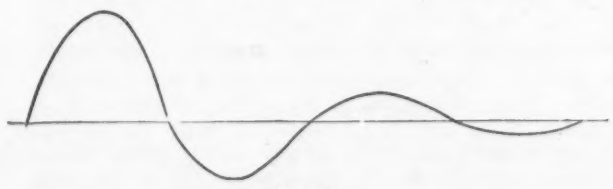


FIG. 6.

with respect to time, according to a logarithmic law. It is the ordinary form of dampened harmonic oscillations and is what would be expected from purely theoretical considerations.

### MULTIPLE RESONANCE.

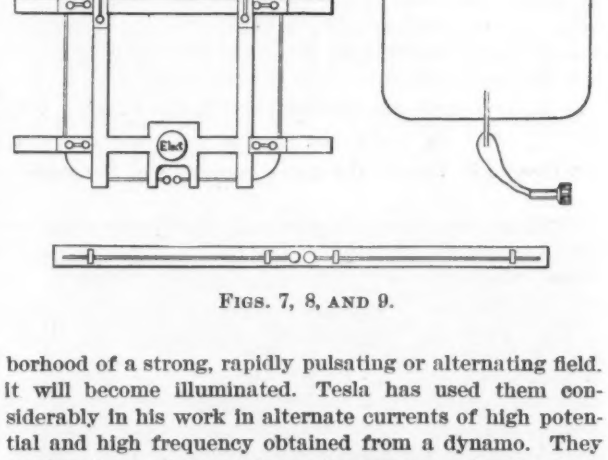
Messrs. Sarrasin and De la Rive† have observed, first, that a circular resonator gives always the same wave length, even when the dimensions of the exciter are varied within certain limits; and second, that with the same exciter resonators of different size will indicate different wave lengths for the same oscillation. For instance, with an exciter having square condenser plates of 20 centimetres per side, the wave length of the radiated oscillation was determined by a resonator of 35 centimetres diameter to be 147 centimetres; with a resonator of 50 centimetres diameter the wave length appeared to be 189 centimetres; and with a resonator of 75 centimetres diameter, the wave length was 299 centimetres. From this it was reasoned that the wave was a compound one, and that the action of the different resonators had been to separate the wave into its elements, similar to the action of the Helmholtz acoustic resonators used in the analysis of sound.

This does not agree with theory and the form of the wave plotted in Fig. 6 points to a different explanation. The intensity of the vibrations propagated by the exciter diminishes so rapidly that the first oscillation is much more pronounced than any succeeding one. The action of this strongly dampened vibration is practically the same as that of a single oscillation. This single oscillation will excite the resonator, proceed to the mirror, be reflected back, and if the period of the resonator is such that the reflected oscillation will act in the same direction as the next incident oscillation, sparks will occur at the air-gap even though the periods of the resonator and exciter are not in accord. These oscillations will set into action resonators of very different period, but the resonator which is in harmony with the exciter will give the longest sparks.

### RECENT IMPROVEMENTS IN DETECTORS OF ELECTRICAL OSCILLATIONS.

Thus far we have only considered the circular or rectangular resonator as a detector of electrical oscillations, and the spark micrometer as a means of obtaining quantitative results. The action of this resonator was likened to an open organ pipe. A linear resonator can be employed equally as well, formed of two straight rods, each one-fourth of a wave length long, placed in a straight line and having the micrometer air gap at the middle point (see Fig. 9). The action of the linear resonator is analogous to a closed organ pipe.

Geissler tubes have also been employed as detectors of electrical oscillations,* but they cannot be used to give quantitative results. They should be exhausted to about the same degree as an incandescent lamp, and in fact a lamp in which the filament is broken forms an excellent detector. They may be with or without electrodes. When one of these tubes is placed in the neighborhood of a strong, rapidly pulsating or alternating field. it will become illuminated. Tesla has used them considerably in his work in alternate currents of high potential and high frequency obtained from a dynamo. They exhibit the nodes and loops formed by reflection in a striking manner, and are most excellent for lecture demonstrations. They should be covered with wire gauze to protect them from the direct action of the exciter. They are also used to indicate the passage of minute sparks in the resonator by being attached to one side of the spark gap.



FIGS. 7, 8, AND 9.

Also, for the indication of minute sparks, the explosion of gases by the resonator air gap has been used.

Prof. Birkeland,† of Christiania, has employed for a similar purpose a telephone in connection with a condenser in the resonator circuit. This is shown in Fig. 8. Since there is a node at the point opposite the spark gap the resonator can here be cut open and a pair of small condenser plates inserted without affecting the action of the circuit. If the terminals of a telephone be connected to these plates the telephone receiver will give a sharp click every time a spark occurs in the air gap.

Among the most satisfactory methods of measuring quantitatively the energy of electrical oscillations of high frequency are (1) the elongation of a thin wire by heat.‡ (2) the bolometer by Rubens;‖ (3) the electrometer, by Bjerknes;¶ (4) the thermo element, by Klemencic.§

Fig. 7 shows the resonator with extensible sides fitted with an electrometer as used at the Physical Laboratory of Cornell University.

*(To be continued.)*

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* *Philos. Mag.*, vol. 28, p. 48, 1889.
† *Wied. Ann.*, January, 1889; or *Nature*, XXXIX., p. 452.

* Fred. T. Tranton, *Phil., Mag.*, vol. 32, p. 80.
† *Comptes Rendus*, 110, p. 72.

* J. J. Thomson, *Phil. Mag.*, vol. 32, pp. 331, 445; also E. J. Dragoumis, *Nature*, vol. 39, p. 548.
† *Wied. Ann.*, 47, p. 583, Nov., 1892.
‡ W. Gregory, *Phil. Mag.*, Jan. 1890.
‖ *Wied. Ann.*, 42, 1891.
¶ *Wied. Ann.*, 44, 1891.
§ *Wied. Ann.*, 45, 1892.

## Conductors and Insulators.

BY REGINALD R. FESSENDEN.

In the latter part of the year 1891 a series of articles on insulation was promised by the writer to the editor of THE ELECTRICAL WORLD. From that date to this, however, no time was found to fulfill that promise, although a synopsis of the material already prepared was delivered in the form of a lecture before the Library Association of the Pennsylvania Railway Company, at Altoona, in January, 1892. In taking up the subject recently it was judged best, in view of the great advances recently made in our knowledge of molecular actions, to enlarge the subject so as to include the allied subject of conductivity. It is proposed first so give a brief account of the theory of conduction, and then to give details of the practical use of substances as conductors and insulators.

Of the history of the subject it is unnecessary to say much. We have no better insulators now than those originally used, *i. e.*, shellac varnish, etc. The only improvement has been in the discovery of insulators having greater mechanical strength than those above referred to. With regard to conductors, however, the case was different. In spite of the work of many Continental and English investigators, it is doubtful if the resistance of any metal was known to within twenty per cent., until Matthiesen took the matter in hand and by a series of most accurate and painstaking experiments gave us a set of values which it is doubtful if the future will change even in the fourth figure. Since that time the only advances have been made in the direction of lowering the coefficient of increase of resistance of wires with temperature, and of rendering less their thermo-electric effects when used as standard.

Before taking up the theories of conduction a brief sketch of our present knowledge of the molecular properties of matter will be necessary, as these are seldom or never referred to in books on physics—partly, no doubt, because advances in this direction have been so rapid during the last few years that textbooks have been unable to keep up with them, and partly because the authors of such books have ignored almost entirely all foreign periodical literature, where alone most of these discoveries have been recorded. Our materials for work are only two, matter and ether. The vortex atom theory of Lord Kelvin is probably well known to the reader. It arose from the discovery that a whirpool closed on itself so as to form a ring, was, in a frictionless fluid, indestructible. Prof. J. J. Thomson attacked some

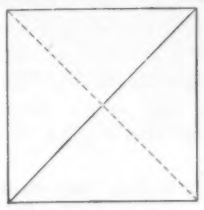


FIG. 1.

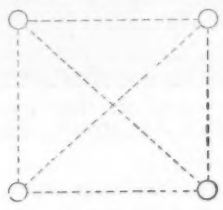


FIG. 2.

time ago the problem of the action on one another of a number of such vortex atoms, and it seems from his results that they would not behave unlike what we know the actual atoms do.

Of late years considerable advance has been made in the stereotomy of the atoms by Van't Hoff, Wislicenus and others. The atoms appear to have a definite shape. Carbon, for instance, is probably shaped like a tetrahedron, as in Fig. 1, its four valencies acting at the vertices of the four solid angles of the figure.

There is abundant justification for this supposition, and this theory has already rendered invaluable aid in the prediction of possible isomeric compounds, and the explanation of obscure chemical reactions, such as the transformation of maleic into fumaric acid.

Nothing further is definitely known of this subject. We are at liberty, however to imagine the carbonation as formed of four or some multiple of four vortex rings, one set at each of the vertices of the solid angles of the tetrahedron shown in Fig. 2. An imaginative mind may be still further provoked by the recollection of the fact that the number of kinds of space into which crystallographers have found it possible to form, starting from an infinite number of points in space, so arranged that each point is similarly situated with respect to every other point, is 67 or just the number of the well-defined chemical elements; so that one might image to one's self a vast portion of the "atom dust" made of vortices, from which Mr. Herbert Spencer develops his universe as splitting up in these 67 ways to form the elements.

As regards the ether, we have not learned very much since the time of Maxwell, though of course advances have been made in our knowledge of the properties of frictionless fluids. What we have learned about ether since the grand discovery that it is the means of transmitting the impulses of both light and electricity, is that it is not by any means the simple substance it was first supposed to be, and that it cannot be either a simple fluid or a simple jelly; for if it were, kinds of waves, and other phenomena which do not appear to exist, would be observable. Thanks to the work of Lord Kelvin, Fitzgerald and others, we know that ether behaves as if it were made up of a mixture of two things, one a skeleton of elastic material, the other a fluid. As Lord Kelvin puts it, it is "like water in a sponge." The skeleton part may be supposed to be made up of vortex filaments or whirlpools stretched out till they are like rapidly spinning threads. The fluid part may be supposed to consist of the ether pure and simple, flowing in like a film between the vortex filaments, and being incompressible.

There is a relation between the ether and matter, but there is no knowledge of what it is. A certain quantity of ether seems to be bound up with the atoms of matter, as is shown by Fizeau's experiment with the stream of water. He found that light traveled faster with the stream of water than against it. To take an analogy, if we strike a stationary wire, a wave will travel away from the place of striking at a certain velocity. If, however, the wire be one in the moving wire rope of a cable car system, the wave will move more quickly in the direction of motion of the rope than in the opposite way. Similarly, Fizeau's experiment seems to show that a part of the ether travels along with the water.

But there are other experiments which seem to contradict this theory. For instance, a part of the ether should be carried around with the earth in its daily revolution, but this does not seem to be the case, and the experiments of a number of men, as Michelson and others, have not tended to explain this contradiction.

A certain amount of electricity seems to be always connected to each atom of matter, and the atom always holds this quantity or a multiple of the quantity by some whole number. This quantity is called by Prof. Oliver Lodge the "natural unit" and possibly the "atom" of electricity. It may be arrived at in the following ways, all of which give nearly the same result:

1 The mean free path of the molecules of a gas is found by calculation to be:

$$L = \frac{1}{\pi \sqrt{2}\, n\, s^2}$$

as given by O. Meyer, where:

L = length of mean path.

n = number of molecules in one cubic centimetre.

s = diameter of molecule.

From the phenomena of diffusion of gases we find the value of L. and from it deduce the value of $n\,s^2$, or the sum of all the cross sections of the molecules.

From the variation of gases from the law $p\,v =$ constant, due to the fact that the atoms have an appreciable size, we can find the ratio of the size of the atoms to the space occupied by them.

Then since the total cross-section of the atoms in a vessel, multiplied by the diameter of one of the atoms, must equal the total volume of the atoms (supposed cubical), we can find the diameter of the atoms by dividing the volume actually occupied by the atoms themselves by their total cross-section $n\,s^2$. The result as given by Loschmidt for hydrogen is $6 \times 10^{-8}$ centimetres

2. From the phenomenon of surface tension we see that when a molecule is lying on the surface of a fluid it is only acted on by forces on one side. When it is in the middle of the fluid it is acted on from all sides, and when in the state of vapor it has practically no cohesive force acting on it at all. So that if we take an atom from the middle and bring it to the surface, we do half as much work as if we carried it from the middle to the outside, i. e., vaporized it. The work required to make one square centimetre of water surface is .088 gramme-centimetre. The latent heat of water vapor is about 600 calories at 0° C.

Therefore 300 calories is the quantity of work necessary to spread one gramme of water out in a surface so that every molecule is on the surface, i. e., the surface is one molecule thick. Three hundred calories reduced to mechanical work give $127 \times 10^7$ gramme-centimetres. Therefore we can make from one gramme of water $1.44 \times 10^8$ square centimetres of surface; and as the surface of the water is one molecule thick, the diameter of the molecule is $.7 \times 10^{-8}$ centimetres.

3. Lord Kelvin (Thomson and Tait's Natural Philosophy, Part II., vol. I.) shows that, if a plate of copper and another of zinc be made truly plane, and brought face to face at the distance of $\frac{1}{100000}$ of a centimetre, the force of attraction between the two, when connected electrically under these conditions, is equal to two grammes weight per square inch. Therefore the work done in bringing these plates together from infinity is equal to $\int_{\infty}^{r} \frac{q}{r^2}\,dx$:

and since the force $\frac{q}{r^2} =$ two grammes, this is equal to

$\frac{2}{10^5}$ gramme-centimetres of work. If, then, 100,000 in all of such plates be brought together, i. e. 50,000 zinc and 50,000 copper, the total work done is two gramme-centimetres. The weight of these plates (one centimetre square and piled up so as to make a total thickness of one centimetre) is eight grammes. From the specific heat of brass, 4,030 centimetre-grammes of work heat one gramme one degree centigrade. Therefore the work done in bringing together all these 100,000 plates would heat them only $\frac{1}{16\,1/3}$ of a degree centigrade.

If the plates were one million times thinner than the above, the temperature would be raised about 62 degrees C., which is approximately what we would actually get by mixing together four grammes zinc with four grammes copper to form brass, if it would equal approximately their heat of combination. But two metals are chemically combined in this way only when the plates are one atom thick. So we may take the approximate size of the copper or zinc atom at about $10^{-8}$ centimetres.

It will be seen that all these results are of the same order of magnitude, and we may take the size of the atom as between $10^{-8}$ and $10^{-7}$ centimetres diameter.

To return to our atomic charge: A cubic centimetre of silver has $10^{24}$ atoms, if the diameter of a silver atom be taken as $10^{-8}$ centimetres Its weight will be 10.5 grammes. One coulomb of electricity will electroplate about 1.12 milligrammes of silver; i. e., the quantity of electricity held by as many atoms of silver as would weigh 1.12 milligrams is one coulomb. Therefore our cubic centimetre of silver will have 10,500 ÷ 1.12 coulombs on its atoms; and as there are $10^{24}$ atoms, each atom will have $(10{,}500 \times 10^3) \div 1.12$ coulombs, or about $10^{20}$ coulombs.

The capacity of an atom whose radius is $.5 \times 10^{-8}$ centimetre is in electro-magnetic units about $.5 \times 10^{-20}$ farads. Therefore the potential of each atom is in the neighborhood of two volts, being greater for those atoms which are smaller than silver, and vice versa. As we shall see, it is these changes which give rise to all the physical (and according to Prof. Oliver Lodge the chemical also) properties of matter. They determine the conductivity, dielectric strength, electrolytic equivalent, rigidity, Young's modulus, tensile strength, surface tension, melting point, expansion, critical temperature and pressure, refractive index, specific inductive capacity, in short, all the manifestations and changes of matter.

## A Method of Calibrating Ammeters and Voltmeters at Central Stations.

In a paper on Central Station Notes, read by Messrs. Brew and Ledger, they give the following method for checking ammeters and voltmeters:

There is nothing at all original about it, it being essentially the same as has been in use for some years past. A D'Arsonval galvanometer (with a magnetic shunt), D'A, is in series with a resistance box ranging up to 10,000 ohms, R, and across the latter is connected a standard cell, C, a fairly sensitive galvanometer, G, and any unknown but high resistance, $R_1$. Suppose the standard cell to give, say, 1.435 volts at a certain temperature, and let R be adjusted to 143.5 ohms, and an adjustable source of P. D. be connected to A and C, it is evident that when on pressing the key, $K_1$, there is no deflection on G, the current in R, and, therefore, in D'A, is one milliampere, and by adjusting the magnetic shunt this current may be made to produce a deflection on D'A of, say, 100 divisions. This experiment can be tried at any time, and should the deflection be found to have altered, it can be re-obtained by adjusting the magnetic shunt.

Now, to use the instrument as a standard voltmeter. Suppose its resistance is 10 ohms, then, if R be adjusted to 990 ohms, the total resistance in the circuit will be 1,000 ohms, and, therefore, one volt gives 100 division deflections. Suppose the scale to range from 0 to 500 divisions, we thus have an accurate range of measurement up to five volts. Now increase R + G to 10,000 ohms, we thus get a range to 50 volts; again R + G = 10,000 ohms and 1-10th shunt in G, we have a range to 500 volts. We have here assumed that the D'Arsonval galvanometer gives deflections throughout its range which are proportional to the currents passing, i. e., 500 divisions is caused, for instance, by a current five times as strong as that giving 100 divisions. This, we believe, always can be relied upon if the instrument is carefully made and the coil suspended so as to hang from its point of support, viz., with its centre of gravity vertically beneath the point of support—which is effected by causing the lower connection of the swinging coil to be made of a thin spiral of wire offering no torsional rigidity, as explained by Prof. Ayrton in his remarks on Capt. Sankey's paper.

Having thus obtained an extremely accurate voltmeter, it now remains to be seen how the arrangement can be made to act as an ammeter. A choice of two methods is open to us. One method is to put a silver or copper voltmeter in series with the strip, and adjust it so that a certain steady deflection is produced on D'A (which is shunted to the strip) and afterward determine from the increase of weight of the voltmeter plate what current has been passing. This, though an extremely accurate method, takes time, and is not very easy of application. In the other method, the known resistance, K (which must be capable of carrying one ampere without appreciable temperature), is inserted in place of the voltmeter and the standard cell placed across its terminals as shown. For the sake of convenience, suppose K = 1.435 ohms and S = .01 ohm; then if the main current be adjusted until on pressing the key, K, no deflection is shown on G, we know that one ampere is passing, and, therefore, .01 volt is the P. D. at terminals of S. Suppose D'A to have 10 ohms resistance, and all R is to be short-circuited, then the current in D'A will be .001 ampere, which, as we have before seen, gives a deflection of 100 scale divisions. This is an extremely simple test, which can be applied in a minute or two, and shows exactly if the resistance, S, has altered in value. Supposing, however, it has the value mentioned—namely, .01 ohm—then we have, as table below shows:

| Resistance in a D'A circuit. | Value of 100 scale divisions. | Maximum range, 500 divisions. |
|---|---|---|
| 10 | 1 ampère | 5 ampères. |
| 100 | 10 " | 50 " |
| 1,000 | 100 " | 500 " |

We believe that the method described will give very nearly, if not quite, the accuracy of a Thomson balance and delicate standard voltmeter at a very much lower cost.

## The Design of a Central Station for Incandescent Electric Lights.—I.

BY PROF. E. P. ROBERTS.

### INTRODUCTION REMARKS AND PRELIMINARY SURVEYS.

Many valuable articles respecting electrical station design and construction have been written, and a number of men experienced on the financial, as well as on the engineering, side have advised the importance of "the preliminary survey." Nevertheless, the writer once more enters the field to urge its value, and, in order to give a certain definitiveness to his remarks, presents a concrete example, giving the arguments and conclusions at and for each step. Before, however, proceeding to the study of the special case, a few introductory remarks are offered.

It is evident that an electric light station is a very complex structure the character of each element of which must be understood before the mutual relation of all the parts can be considered. In chemistry, as is well known, each element is studied and analyzed in order to determine whether or not it is what it claims or is supposed to be, and then just that amount taken which will enter into combination with that portion of other elements taken to produce a certain definite product. If of any one element less than the proper amount be taken, all the others suffer as they remain in excess, if nothing worse. If too much be taken it is a waste, even if it be not injurious. Sometimes an element can be replaced by a cheaper one to produce the same result, but oftentimes the result is only temporarily similar. Just so it is with the production of electric light. The elements must be studied and analyzed individually, and their mutual reactions collectively, and their combining numbers satisfied. Insufficiency of any one element results in waste on the part of all—for instance, insufficient copper, or even improperly distributed copper, necessitates unnecessary labor for men, boilers, engines and dynamos, and is attended by poor regulation and all its direct and indirect expenses; and wear and tear on the manager and his conscience, if happily he have one. Too much of one element will also cause increased running expenses and, in addition, increase of fixed charges due to excess of capital invested for larger size. Coal bills are increased by using too large an engine. Each element should be correct in itself and properly proportioned to do its work—no more and no less. Its combining number should satisfy the equation.

The first question when considering the advisability of erecting an electrical station is, Will it pay? The second is, How to obtain one which will pay the maximum possible. In order to accomplish this it is necessary:

First—To decide on present wants.

Second—On future probabilities.

Third—Plan and erect the station therefor.

Fourth—Operate it.

What is the present method of procedure? A number of men have decided to investigate as to whether an electric light plant in their city will not benefit the place, etc., etc., and, more or less incidentally, pay on the investment. Probably some one of the men knows a man "interested in an electric company, but who can give us impartial advice and facts (?)." A talk results and then a meeting. The impartial adviser shows him the company cannot help making 25 per cent., even if they put the light down to where the neighboring town of Fourthville has it. The board of directors state that 15 per cent. is good enough, and they want to beat Fourthville, so down goes the price. Canvassers are started, and contracts for lights, including free wiring, are taken. The same impartial adviser is requested to draw up specifications—he doubtless does his best. Other companies may or may not see their way to bid on them. The plant, like Topsy, grows—it starts, the local papers are full of it for a while, then silence—and then they are again heard from. Dividends are always for "next year, when so and so is done."

A slight advance on the above method, though but small as measured by results, is when the prospective investors appoint a committee, consisting of a lawyer, a banker, a merchant, a politician and, probably, the local electrician—a graduate of "The Call Bell College" or possibly the "Ticker University." The committee visit various plants, probably in company with an agent of some manufacturing concern; then visit the works of the manufacturing company, and return home with just that amount of information which is generally credited as being "a dangerous thing." The station is built, possibly each element is good of its kind—though, probably, poorly installed as to foundation, etc.—but the general design is probably not the best fitted for present requirements, and unquestionably not for future needs. Quite likely the price for light is fixed too low, and the running expenses are found to be much higher than anticipated. When the time comes, as it generally does even to any station, the increase is denied, the old plant will not "fit in," and really should be thrown away, though probably it stays to assist in making up a "composite" station. All the men in the committee may be admirable men in their respective lines, but they are not fitted to design an electrical station any more than a cemetery—and if they attempt it they will as surely bury their money in one as their friends in the other. The banker, for instance, would be rather surprised if requested by a minister and by a professor of Greek to join with them to start a bank in which they would have the balance of power; but he would be safer in that case than in the one above considered, as he could at least give good advice to his colleagues. What is needed is the service of a man who has studied just such work before. Every electrical engineer is not a station designer, and still fewer are good preliminary investigators, because to be such it requires an experience as a manager. The profession of the electrical engineer is not merely a distinct one, but has many subdivisions. The man needed for the work considered is one who can go to the town, and then, after studying the conditions, make a statement somewhat as follows:

Gentlemen—In accordance with your instructions, I beg leave to report as follows:

That your city is now lighted by a gas company which is furnishing a fair light at $2.50 (?) per M. They have (or have not) the goodwill of the merchants, who express (or do not express) themselves as desirous of obtaining illumination from another source. The present net price of gas ($2.50 per M., 10 per cent. off before the 10th of the month = $2.25) would necessitate 1⅛ cent per 16 c. p. lamp to be obtained in order to compete on the basis of one 16 c. p. incandescent electric lamp against one 5-foot gas burner, which is supposed to give 16 c. p. and which, with proper burners, is (or is not) obtainable from the gas now furnished. As the gas company have their plant, and as they are making money (quote price of stock, or other pointer) an electric light company may find it necessary to compete with gas at $1.50 per M., equivalent to ¾ cent. per 5-foot burner per hour. I believe this can be done, and submit the following figures for your consideration.

The accompanying map shows the number and location of lights which your committee (and myself) believe can be secured at the start, and the number and location of those which can probably be secured within six months after commencing operation. Also what the committee deem the probable direction of growth of the city, and the lighting requirements within the next few (5 to 10) years. Also (and this is important) the location and power of such motors as are likely to be used at once, or in the not distant future. Also the committee have obtained options on the properties marked 1, 2 and 3.

(Next follows a description of the plant necessary to supply the demand, which could be erected at locations 1, 2 and 3, the cost of each and its comparative value for present and future use. This matter will be more fully treated under the heading "Choosing a Site." Next follows an estimate of cost of operating each station and income desirable therefrom.)

The committee then study the report and make such additions and changes as seem desirable on matters with which they are acquainted, and ask reasons for everything which they do not understand. They cannot, probably, understand the scientific principle of the mechanisms, or their mechanical or electrical fitness for the purpose designed; at least, they cannot do so to an extent which makes their conclusion as to comparative suitability of any great value. They can, however, understand matters in a general way, and somewhat appreciate how variations will affect dollars and cents, provided it be properly explained by one who knows what he is talking about, and can use every day English instead of hiding ignorance by a flow of generalities pricked out with technical terms.

Specifications can then be prepared which will cover all essentials, but still render it possible for competing firms to bid, and to figure on the best they have, great care being exercised as to guaranties, dates of shipment, forfeitures, etc.

A man who is competent to give really good advice of the above character cannot, in the nature of things, be a cheap man, but he is an economical man. To prepare preliminary plans takes time. The professional adviser must go to the place and spend considerable time investigating. Architects are paid 5 per cent. to design and superintend a building. It is fully as important, probably more, to properly design and construct an electric station as it is an office building, but very few are willing to pay $5,000 on a $100,000 station for the design and superintending of erection, and this after the general size and type have been decided, which is often the case when an architect is called, and to pay nearly, if not quite, as much more for the preliminary work, which may take even longer, and for properly performing which there are even fewer men trained. With the prices generally ruling during the past year or two, and the efficiency of the apparatus manufactured, there are few places where an electric light plant cannot now be installed and pay a handsome return on the investment, provided the plant erected is the one best suited to the place, and that it be efficiently operated. Older companies intending to enlarge have usually a rather large item on their books called "franchise for patent rights," or some such title, and which might best be changed into "Profit and Loss," and also an "Experience" account, which is a heading not appearing but having an interesting existence. Such older companies often pay large sums for "experience" which they might have obtained for comparatively little by applying to the right man. That they do not do so is due to the fact that there have been, until recently, very few men competent to advise who were not in the employ of some manufacturing company, and also to the disrepute into which the title of "expert" has fallen. There are many good mechanical and electrical experts in the employ of manufacturing and contracting companies; but even in the large companies the number of men who can make preliminary investigations and draw conclusions therefrom, and then make final plans and carry the same to completion, is small, and their time so valuable that the purchasing company will not pay it; and it is only by taking time that a complete investigation can be made. Planning a station merely from a map of the town is not infrequent, but the results cannot be the best; as, for an example of even a small matter, comparatively speaking, the designer cannot judge as to the best streets for pole work.

A competent man will, by taking time, produce a station costing certainly 10 per cent. less to operate than if the same man did the work hurriedly, or it was done by an incompetent man. This is a conservative statement. Would it not be wisdom to pay 10 per cent. of the first cost of a station to have it properly designed and started if, thereby, a return of 10 per cent. a year was obtained? The answer is evident. If 10 per cent. dividends so result, and that should be all the company pays, it means that the money paid the designer pays 100 per cent. interest and 90 per cent. of the capital invested pays none. From this standpoint "good advice" would seem to pay the largest dividend of anything invested. This is unquestionably true in every business; but men have rushed, or been dragged, into electric lighting, who seem to have utterly lost sight of it, often because of the remarkable figures shown by prospectors, and which have given rise to the methods of the speculator, rather than of the sober-minded man investing in a legitimate business.

Proper preliminary investigation results in accurate knowledge of the conditions to be fulfilled, and the cost and income under various conditions. The project can then be taken up or abandoned.

Proper plans—reliability and economy of operation result therefrom.

Correct specifications and contracts—all competitors can bid to install the best apparatus they manufacture without handicap, only being limited by the essential feature of the design, and by such general specifications as control electrical and mechanical devices of the character specified. The apparatus will arrive as needed (or heavy forfeitures result) and the station start on time.

Proper inspection of installation is very important, and only thereby can be obtained reliable work, especially as regards foundations, wiring, etc.

Proper advice as to operation, both financial and mechanical, insures then that friction between the public and the management will be a minimum, that the method of keeping costs will be comprehensive, but not complicated—in other words, suited to the lighting business and especially to the case in hand—and that maximum results with minimum expenditure will be obtained at and from the start, and not after charging several thousand dollars to experience account. These managers who have, as has the writer, carried into effect increase of charge for light, and decrease of expense of operation, both necessitated by a false start, will realize the force of the above remarks. The reason why it is advisable to have good advice from the start might be summarized as:

Good Advice = Dividends.
Bad Advice = Assessments.

A few of the many reasons have been presented as to why good advice from the start may make the difference between success and failure, and many more might be added, but in order to get at the actual design of the contemplated station no more time will now be given to arguments, but the study of the conditions for which the station is designed and the methods of meeting the requirements will serve for argument and illustration.

The town for which the following series of designs has been prepared is a supposititious one. It is supposed to have 10,000 inhabitants, and the number of stores, etc., of each kind is the average of a large number of towns of 10,000 inhabitants, as given by Bradstreet's.*

The number of lights in each place and the use of same is according to the experience of the writer for towns of the class considered. The use of light in cities and towns is very different, and also cities and towns of the same size in different parts of the country and often even close together have not the same habits. Manufacturing towns, county seats for farming counties, residence towns near large cities, etc., are examples of types; each place must be carefully studied by itself.

The subject will now be continued as though it were a portion of the report of the consulting electric light station specialist, made to the investigating committee before considered.

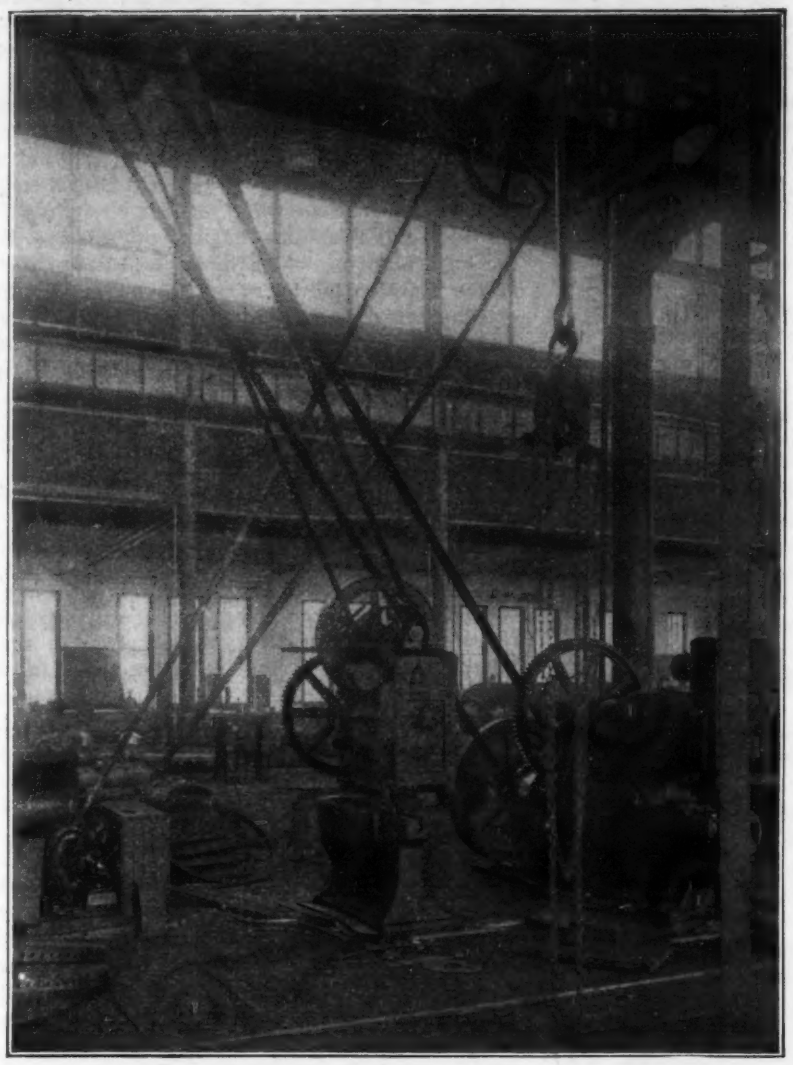
*(To be continued.)*

* In investigating this point the writer noticed the fact that the more saloons the fewer the bakers and butchers. Saloons are good customers for lighting companies, but also the more healthy the conditions under which the town the better for its prosperity. For direct and evident income lighting companies make most out of saloons and brothels, least from churches, butchers and grocers.

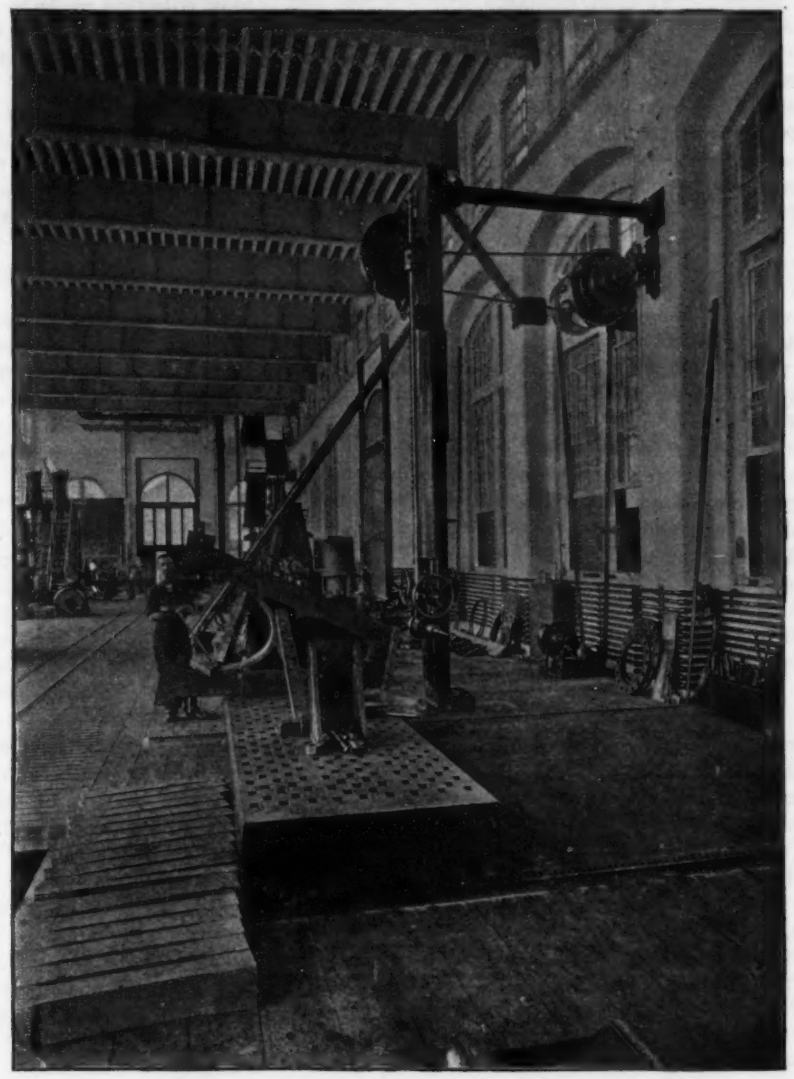
## The Application of the Electric Motor in Commercial Industries.

Mr. Thwaite, in speaking of losses in mechanical transmission, quoting from Flather, says that the power used by the machinery itself will average 40 to 50 per cent. of the total power expended; this includes elevators, fans and blowers. In shops using light machinery and a foundry, results would be the same, but without the foundry the loss of power in the transmission would be from 30 to 40 per cent. In conclusion he says that with electric transmission a saving varying from 16 to 75 per cent. may be obtained.

One of the best illustrations of the manifold applications of the electric motor in the industries has been brought to our attention by a handsomely gotten up catalogue just issued by the C. & C. Electric Motor Company, which includes a large number of handsome half-tone illustrations of the application of their motor in manufacturing establishments of various kinds. While these are confined to views illustrating the application of a single make of apparatus, they are so varied in character as to well illustrate the broader subject included in the title of this article, and will be instructive and interesting to the layman as well as to the business man who has a personal interest in such applications. Some of these illustrations are so fine and illustrate the subject so well that we reproduce them here. The firm of Fraser & Chalmers, of Chicago, whose reputation as manufacturers of mining machinery is world wide and whose establishment is one of the largest of its kind to be found anywhere, are among those who have substituted the electric motor for the multitude of shaftings which would under other circumstances have been required. They have recently introduced in their foundry one motor of 65 h. p., one of 20 h. p., two of 10 h. p. each, one of 7½ h. p., five of 5 h. p., two of 3 h. p., and three of 1 h. p.; in their pattern shop one of 25 h. p., one of 20 h. p., and one of 15 h. p., and in the boiler shop, six of 10 h. p., and seven of 5 h. p. In this extensive plant the economy of electric power is easily realized, for with separate engines and boilers for each building, or a separate central plant with power transmitted by means of steam or shafting to the various departments, the loss in transmission and the expense of administration are too well known to require comment at this late day. With the substitution of electricity as a means of transmission from the power house, the current in this case is transmitted by three substantial circuits, with a loss of from two to five per cent., to the motors in the various departments above refered to. The steam plant consists of two Fraser & Chalmers Corliss engines, each driving an 80 kilowatt C. & C. standard compound dynamo; these latter are designed to deliver motor current at 250 volts, and to supply power and light for the entire works. The motors throughout the shop are provided with automatic cut-off starting switches, so that when the current is cut off at the main switchboard each motor is cut from its circuit, and, in starting, the possibility of injury to motors from the sudden turning on of current from the power house is prevented. The advantage of using many small units of power is becoming more and more appreciated by practical men as the disadvantages of long lines of belting and shafting, which must be necessarily driven whether they are doing much or little work, are realized. In shutting down an electric motor in one part of the establishment the power which it would otherwise consume is at once rendered available in any other portion of the works, and the belting and shafting no longer doing work become idle at once and cease to be a source of expense or detriment to the general efficiency of the plant.

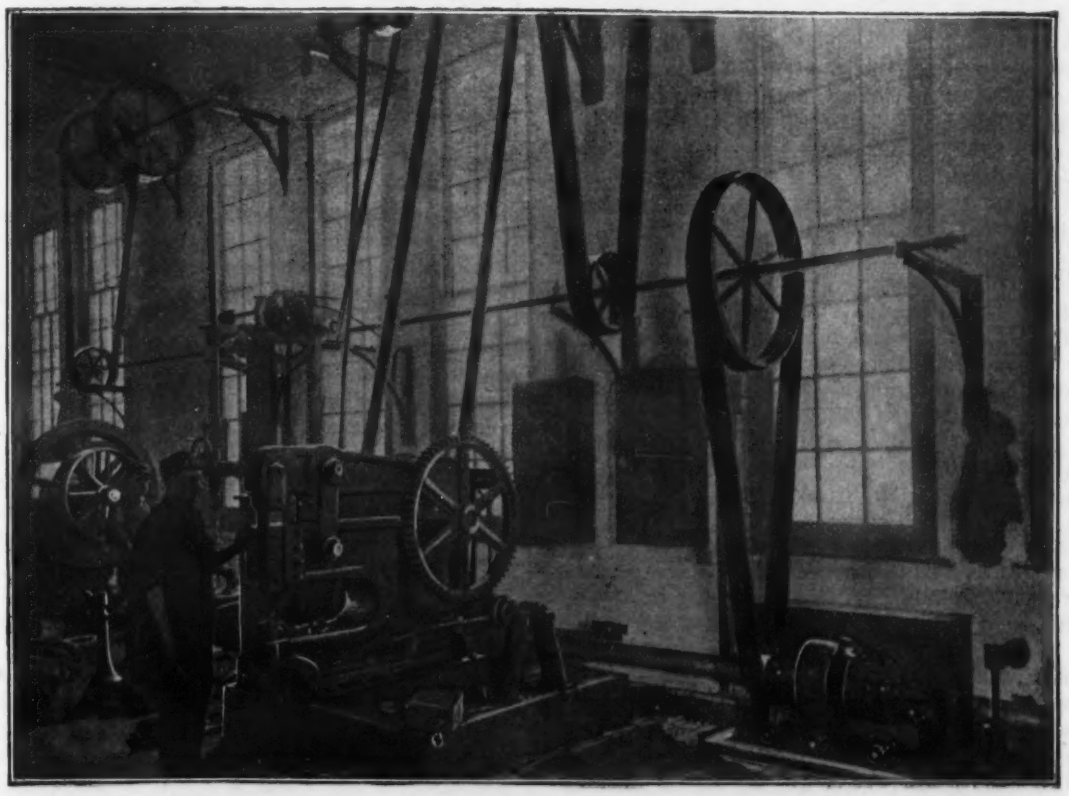


10 H. P. MOTOR RUNNING SLITTING SHEARS AND VERTICAL DRILL.



10 H. P. MOTOR RUNNING LARGE HAND PUNCH, BEVEL SHEARS, TURRET LATHE AND SHAPER.

In the foundry the 65-h. p. motor runs a six and four foot Root blower supplying the draft for the cupola furnaces, a 4,000-pound Reedy elevator is driven by the 20-h. p. motor, and for handling heavy castings an electrically operated Yale & Towne jib crane employing two motors is brought into service. One of these, of 7½ h. p. capacity, is employed for hoisting and lowering the load, while another of 5 h. p., called the trolley motor, is employed for moving the crane along its runway. The 25 and 20-h. p. motors in the pattern shop are employed to operate a 24-inch planer, crosscut and rip saws, two band saws, four lathes and a grindstone, and the 15-h. p. motor in this department is employed to run the elevator. In the boiler shop most of the machines are divided into groups of two or three, which are tributary to a single motor, though in some cases each machine has its individual motor. Those which have been erected in this department have been assigned to the following duties: One 5-h. p. motor runs the boiler plate shears and a large upright drill; the 10-h. p. motor is attached to a large hand punch, bevel shears, turret lathe and 16-inch shaper; another 10-h. p. motor runs the slitting shears and the large boiler plate punch; a 5-h. p. motor is attached to another boiler plate punch, shears and small vertical drill; a 10-foot boiler plate roll and a 20-foot plate planer are driven by a single 10-h. p. motor, while another of the same size drives a Williams, White & Co.'s bulldozer, and still another 10-h. p. motor furnishes power to a large bevel shears and an upright drill and punch; a 5-h. p. motor is attached to two sets of 5-foot sheet iron rolls and an automatic sheet iron punch, and another 5-h. p. motor furnishes power to a No. 1 Root blower which supplies draft for the forge fires.



10 H. P. MOTOR RUNNING LARGE BEVEL SHEARS, UPRIGHT DRILL AND PUNCH.

Thus will be seen to how great an extent the electric motor has already won its way into one of the most conservative lines of manufacturing business in the country, and also the variety of work that it is called upon to perform.

# THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Mr. Ellinger, in the "Wied. Annalen," No. 1, describes experiments for determining the refractive index of alcohol; for 96 per cent. alcohol he found it to be 4.9, a value which accords very well with theory, as its specific inductive capacity has a value which differs but little from the square of 4.9.

MAGNETISM

*Measuring Iron Losses.*—The Lond. "Electrician," commenting on Dr. Duncan's method, and on the subsequent article by Mr. Moore published in The Electrical World Feb. 4, p. 83, says that a much quicker and simpler method consists in winding a coil around the iron samples and measuring with an ordinary wattmeter the power absorbed by the solenoid for different voltages. "The average induction density in the core can be obtained from the voltage, the current frequency and the section of the core; and the watts wasted per unit volume of the core can, of course, at once be found." It claims this to be simpler and more accurate than that suggested by Mr. Moore, as the latter method depends on the induction in the air outside the core where magnetic leakage difficulties are greatest.

UNITS, MEASUREMENTS AND INSTRUMENTS.

*Work of the Congress.*—The Lond. "Electrician," Feb. 3, p. 377, discusses editorially the report made to the American Institute of Electrical Engineers on the work of the coming electrical congress. It says: "The provisional programme contains some useful recommendations and displays a good knowledge of the subjects with which it deals, as well as the needs of the hour. That a set of definitions of physical quantities for international use should be contributed from America to Europe is a sign of the times. We welcome this report as an interesting landmark in the development of real American science." In its criticism it says that the definition of impressed E. M. F. is not well worded; it suggests that the volt be defined by the ampere and the ohm; it doubts the utility of the unit "reluctivity"; it prefers the term horse power to kilowatt; it suggests using the word "plant" instead of "installation"; of the seven names suggested it says the majority stand a good chance of adoption. It approves of the name "henry." It criticises the term candle-foot as not being the product of candles and feet, but it suggests nothing better.

*Practical Rules.*—Prof. Forbes, in the Lond. "Electrician," gives the following eminently practical and very useful rules, some of which have been published before: The loss by heat in copper conductors (in dynamos or on lines) is approximately as follows: 1. With a density of 1,000 amperes per square inch, every 1,000 cubic inches means a loss of 1 h. p. 2. For greater accuracy, add to the horse power thus obtained one-tenth of its value. 3. For other densities of current, multiply the value thus obtained by the density, and divide by 1,000.

Mr. Lane's rule for measuring water power: With a hydraulic motor of 75 per cent. efficiency, it takes 1 acre of water 1 foot deep to give 1 h. p. for 1 hour with 1 foot of fall. Prof. Forbes' formula for the same is: With 80 per cent. efficiency, one cubic metre per second falling one metre develops 10 h. p.

Lord Kelvin gives the following rule: A metre is very nearly three feet three and three-eighths inches, which is easily remembered. For measuring the degree, minute and second in terms of radius = 1, Prof. Forbes gives the following rule: After the decimal point, 1 degree is one nought and a one (exactly 0.0175); 1 minute is three noughts and a three (exactly 0.00029); 1 inch is five noughts and a five (exactly 0.000004848).

*Meters.*—Dr. Silvanus Thompson, in a lecture, stated that up to the present time there exists no reliable gas meter, while we have already reliable electric meters. No gas meter indicated 1-10th part as correctly as the present electric meters in use at central stations. The meter of Elihu Thomson, he states, was one of the latest and most perfect. He mentions an ingenious adaptation of the pendulum meter in which one pendulum moves the hands and the other the clock dial, the difference measuring the amount in ampere hours; he states that tests showed this meter to be "marvelously good."

MOTORS.

*Raising Curtains.*—In the French National Theatre in Paris an electric motor has been introduced to operate the drop curtain. The curtain is suspended by five parallel ropes which run over an equal number of pulleys above the curtain and are wound together on a wooden drum belted to an electric motor. The curtain weighs 880 pounds and is entirely balanced by a counter-weight, the motor having to overcome only the friction, which amounts to 2 h. p.; a shunt motor is used with carbon brushes, and the current is obtained from a central station. There are three different speeds of descent, 5 feet, 3½ feet and 2½ feet per second, respectively; the speeds for ascent are 2½ feet and 3½ feet per second; the range of the curtain is about 31 feet. The current required is from 10 to 60 amperes (presumably at 110 volts). The only objection made to this new innovation is by some old fogies, who object to the absence of the "majestic slowness" of the old curtain.

In commenting on the alternating motor of Mr. Brown, described in these columns last week, the Lond. "Electrician" says that it is the closest approach to the ideal so far developed. "Whether this solution is a final one remains to be seen, but all indications at present point to the induction motor first invented by Elihu Thomson as the motor of the future."

An important advantage in favor of electric motors on ships in place of hydraulic or steam engines is, as suggested in the Lond. "Electrician," that they are not affected by frost. The recent serious injury to the machinery of a British man-of-war by frost showed the great importance of this advantage.

ARC AND INCANDESCENT LIGHTS.

*Diffusion of Light.*—Mr. Sumpner, in a very able and instructive article begun in the Lond. "Electrician," Feb. 3, gives some very useful information regarding the effect of the diffusion of light, which is well worth the careful attention of any one installing electric lights. The following abstract gives briefly all the principal parts of the paper. He states that the important part played by diffused light is but little realized, as few seem to understand the great extent to which the illumination of rooms and open spaces is increased by the repeated reflections to which the light is subjected before it is finally absorbed. In many cases the illumination due to diffusion is four or even five times as important as that due to the direct rays. Diffusion is, moreover, of importance in altering the character of the illumination, making it much more pleasant. He cites the illumination of an arc lamp and that of daylight; the former, though much less bright, is much more trying than the latter. The illumination of the pavement from a street arc lamp is a little over one-half a foot-candle, while that of bright daylight often exceeds 30 foot-candles; the eye can, therefore, easily bear 60 times more light of a diffused nature than that received from an arc lamp; this difference is due to the concentration of the rays from the arc light. Concentrated light causes a partial closing of the pupil of the eye, thereby cutting off some of the light and producing the same effect as if the illumination were diminished. If a globe absorbes 30 per cent. of the light, but diffuses it so that the pupil of the eye increases in diameter by 20 per cent., the amount of light received by the eye is actually increased and not diminished by using the globe. The fact that globes often absorb 30 to 40 per cent. of the light is, therefore, not so important as is often imagined. One of the most useful properties of diffused light is that is does not cast shadows.

To show the extent to which the action of the walls of a room increases the illumination, he supposes 100 c. p. of direct light in the room and an average reflecting power from the walls, ceiling, etc., of 50 per cent.; as this reflected light is just the same as any other light, it is equivalent to an additional light of 50 c. p.; this is again reflected, forming a third light of 25 c. p., and so on, the sum of all, including the original hundred, will be 200, so that the effect of the walls is just as if the lamps within the room were of 200 c. p. instead of 100. If the reflecting power is 80 per cent., the increase will be from 100 to 500, in which case the diffused light will be four times as important as the direct light; this result it is quite possible to realize with well whitewashed surfaces. In an extreme case of walls covered with mirrors reflecting 92 per cent., the increase will be from 100 c. p. to 1,250.

Light in an inclosed space must go on increasing until the walls absorb the light as fast as it is produced. If Q is the direct light produced per second, and q the quantity falling on the walls, then $q = Q + rq$, in which r is the average reflection from the walls in per cent. divided by 100. Hence the increase of illumination by reflection must be in the ratio of 1 to $1 - r$.

The reflecting powers of a number of diffusing surfaces tested by that writer are as follows:

*Reflecting Powers in Per Cent.*

| | | | |
|---|---|---|---|
| White blotting paper | 82 | Deep chocolate-colored paper | 4 |
| White cartridge paper | 80 | Plane deal (clean) | 40 to 50 |
| Tracing cloth | 35 | " " (dirty) | 20 |
| Tracing paper | 22 | Yellow cardboard | 30 |
| Ordinary foolscap | 70 | Parchment (one thickness) | 22 |
| Newspapers | 50 to 70 | " (two thicknesses) | 35 |
| Tissue paper (one thickness) | 40 | Yellow painted wall (dirty) | 20 |
| " " (two thicknesses) | 55 | " " " (clean) | 40 |
| Yellow wall paper | 40 | Black cloth | 1.2 |
| Blue paper | 25 | Black velvet | 0.4 |
| Dark brown paper | 13 | | |

From this it will be seen that even a dull looking wall will reflect 20 per cent., while one of ordinary tint will reflect from 40 to 50 per cent. and a good, white surface reflects over 80 per cent. A clean, whitewashed ceiling reflects as much light as an ordinary mirror. A well whitewashed room, therefore, needs only one-fifth the candle power than if it were painted black. He quotes Mr. Preece's rule which, for arc lights in halls, large buildings, etc., is that lamps should be arranged so as to shed light uniformly over the surface, the amount of light being one-half a watt per square foot of area to be lighted; for incandescent lamps in private houses use one watt for every square foot of surface of the floor space. For 16 c. p. lamps at 4 watts per candle, 8 feet above the floor, this rule reduces to dividing the square feet of floor space by 64, which will give the number of 16 c. p. lamps. This rule, however, cannot he relied upon in a too general way, as it does not take into account the different reflecting powers. Mr. Kapp stated that in two equal sized rooms, differing only in the nature of the walls, one required three-fourths of a watt per square foot while the other required 2 watts. Although this is a somewhat exceptional case, it shows the importance of taking into consideration the nature of the diffusion in the room. He states that in many existing cases the amount of light in a room could be doubled by simply removing the wall paper and substituting another of a lighter tint; to double the number of lights would be much more expensive and less effective.

For calculating the average reflecting power of the surface of a room having very different diffusive powers, he gives the following simple formula:

$$r = \frac{A_1 r_1 + A_2 r_2 + A_3 r_3}{A_1 + A_2 + A_3}$$

in which $A_1$, $A_2$, $A_3$, are respectively the areas of the ceiling, walls and floor, and $r_1$, $r_2$, $r_3$, are their respective reflecting powers in per cent., as given in the above table; r is then the average reflecting power in per cent. For the proof of this, as well as other formula contained in this article, see a paper of that writer in Lond. "Phil. Mag.," February. In an example he assumes the values 40, 20 and 20 per cent. for the ceiling, walls and floor of a room of approximately cubical proportions; he finds the value of r to be 23.3 per cent. The formu'a $\frac{100}{100 - r}$ then gives 1.30, which means that the illumination would be 1.3 times as great as if the room were black. If now the ceiling be whitewashed and the walls covered with a light tinted paper, the reflecting powers will be 80, 75 and 20 per cent., respectively, and the illumination will then be represented by 3.00 as compared with black surfaces, showing that it has thereby been made more than double what it was before. For an average room he says 80, 50 and 20 may be taken as the per cent. of reflection from ceiling, walls and floors, respectively; this gives an average reflecting power of 50 per cent., or double the direct light. When the surfaces in a room are colored, the illumination is not only increased but altered. If the walls were red, for instance, the red light might be increased to fivefold, while the light of other hues will not be altered perceptibly. He also points out that a uniformly diffused light is of much greater value in factories, for instance, where delicate work is being carried on; in such it has been found better to reflect the light from an arc lamp against a well whitewashed ceiling by white reflectors below the lamp; such white surfaces reflect fully 80 per cent. He states that an opal globe absorbs quite as much light as the double reflection of these two whitewashed surfaces. The article is to be continued.

Mr. Sydney F. Walker, in writing from Cardiff, appears to think that the arc lamp is doomed, as he believes it will be replaced by the high efficiency incandescent lamps of great candle power, which, it is claimed, will give double the light per watt that ordinary incandescent lamps give.

TRANSMISSION OF POWER.

The Lond. "Electrician," Feb. 3, contains an abstract of Prof. Unwin's third lecture. It deals almost exclusively with water power storage and rope transmission. Those interested in this subject will find it very interesting and instructive matter, containing much useful data. Athough he shows rope transmission in its best light and speaks very highly of it, he admits that except for small distances electric transmission is more efficient. Rope transmission involves considerable cost and does not admit of being measured by meters if distributed to different consumers. He thinks that 300 h. p. is about the limit for a single cable in rope transmission. The efficiency of the latter decreases very rapidly with the distance beyond moderate limits.

RAILWAYS.

*Liverpool Railway.*—The Lond. "Elec. Eng.," Feb. 3, continues its well illustrated serial on the Liverpool overhead railway. In the present installment they have completed the subject of the structure, which belongs under the head of civil engineering, and have begun that portion which will interest the electrical engineers. The train consists of two cars. Each car is mounted upon a couple of four-wheeled bogie trucks of the ordinary American pattern, and upon the outer axle of the truck at each end of a train there is a gearless electric motor

of 70 to 100 h. p. The maximum speed is 30 miles an hour; there are 13 stations on a total length of 6 miles; the maximum speed of the motors is about 300 revolutions per minute. Large full page working drawings of the car are given. The cars are claimed to embody the best points of American and English designs (mostly American, however); the seats are arranged crosswise, as in the middle of the New York elevated cars; there are two compartments in each car—one for first class and one for second—having a seating capacity of 16 and 41 persons, respectively. There are no platforms; the doors open directly into the car, there being three doors on each side; there are no steps. The outside length of a car is 45 feet; the width, 8 feet 9¼ inches; the height from rail, 11 feet; the centres of the trucks are 32 feet apart; each truck has a wheel centre distance of 7 feet; the truck frames are of pressed steel; the wheels are 2 feet 9 inches in diameter, have wrought iron spokes, steel tires and axles and cast steel axle boxes. Besides the Westinghouse automatic air brake, there is a mechanical screw brake. At one end of each car, directly over the motor truck, is a separate compartment for the motorman, containing the controlling apparatus. The cars are lighted by electricity. The contact rail lies between the two other rails; the collector is an ordinary hinged shoe, as shown in the accompany figure; it is quite similar to the device used in the City & South London road.

*High Speed Electric Roads.*—Mr. Dieudonne, in "L'Electricien," gives the first part of a serial on this subject. It is of a general nature, being a sort of introduction to the subject. It is to be followed by a detailed description of the Chicago & St. Louis road and the Brussels-Antwerp projected road.

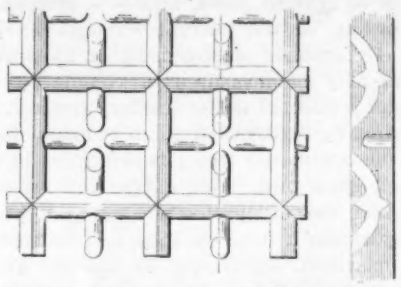
CENTRAL STATIONS, INSTALLATIONS AND ACCESSORIES.

*Sub-Stations for Transformers.*—Mr. Trentham, in the Lond. "Elec. Eng.," Feb. 3, discusses the question of adopting sub-stations in place of the older method of having separate transformers; his conclusions are decidedly in favor of the latter system, which he thinks has been abandoned without due consideration. The following abstract gives his argument practically in full; for simplicity we have taken the pound sterling as equal to $5, and the shilling as 25 cents, which is about 3 per cent. too high; the figures will probably be different in this country, but the general conclusions, being relative, are likely to be the same. He thinks the apparently universally accepted plan of banking transformers in combination with a network of low tension mains is a mistake, and that it is more economical to have one transformer for every half dozen houses. Taking a central station for 10,000 lamps of 16 c. p., with a maximum rate of 6,000 at any one time, he makes the following calculations: Supposing, on the sub-station plan, there was 10 sub-stations arranged on the three-wire system; in each there would be two transformers of each of the following capacities, 3, 6, 12½ and 20 kilowatts, the cost of which would be $1,275; the change-over apparatus, together with regulating cables from central stations, would bring the cost probably to a total of $37,750. For the low tension network, he assumes one 8-c. p. lamp per yard; mains laid on both sides of the street, using well insulated cables, drawn into wrought iron pipes, will cost about $5 per yard, or a total of $6,000 per sub-station, or about $5 per 8-c. p. lamp. The total is $97,750 for 12,000 8-c. p. lamps lighted simultaneously or for 20,000 lamps wired.

On the other hand, his figures for separate transformers, not banked, are as follows: He divides the district into 10 sub-districts for the purpose of comparison. Assuming again one 8-c. p. lamp per yard on each side of the street, making as above a total length of 1,200 yards for each sub-district; each side may be fed by means of six transformers of three kilowatts, the cost of which would be $900; for concentric cables, which includes pipes, laying, junction-boxes, etc., and high tension feeders, would cost about $2,250 per sub-district, or a total of $31,500 for the ten districts, as against $97,750 for the sub-station system.

Regarding the coal consumption, he assumes 20 kilowatt-hours per 8-c. p. lamp wired, or 400,000 per annum. He neglects loss in feeders and mains as being the same on both systems. For sub-stations he assumes an average efficiency of 92 per cent; at 8 pounds per kilowatt-hour will represent 1,543 tons per year. Assuming the loss of watts on open circuit to be 5 per cent. of full load, or taking an average efficiency of 85 per cent., brings the coal consumption up to 1,752 tons; at $5.50 a ton the costs in the two systems will be $1,150 in favor of the sub-station system. The difference in the first cost of the two systems is $66,250, in favor of the second system; allowing depreciation of 7½ per cent., and interest at 6½ on the extra outlay, gives $9,275 a year against an increased coal consumption of $1,150. He concludes that unless the efficiency of the transformers falls below 36 per cent. there is no benefit in using sub-stations with coal at that price.

*Efficiency of the Steam Engine.*—Dr. Silvanus Thompson, in a lecture, stated that, theoretically, one pound of coal can yield 9,452,000 foot-pounds of energy; comparing this with the electric energy produced in a well regulated station, he finds that the efficiency is only about 3 per cent. In analyzing this loss of 97 per cent., he says that one-quarter goes up the chimney, more goes in radiation from the pipes and boilers before the steam gets to the engine and that the engine wastes three-fourths of that, from which he concludes that "It is not electricity but the steam engine that is in its infancy." (This is somewhat misleading; it should be remembered that the efficiency of a steam engine from the cylinder to the pulley is very high, being not much below that of a dynamo; the bad efficiency of the steam engine and boiler as a transformer of energy lies in the fact that only a very small portion of the heat is of such a nature that it can be transformed in the steam engine; the steam engine itself does not waste it, it simply is not available in the steam engine.)

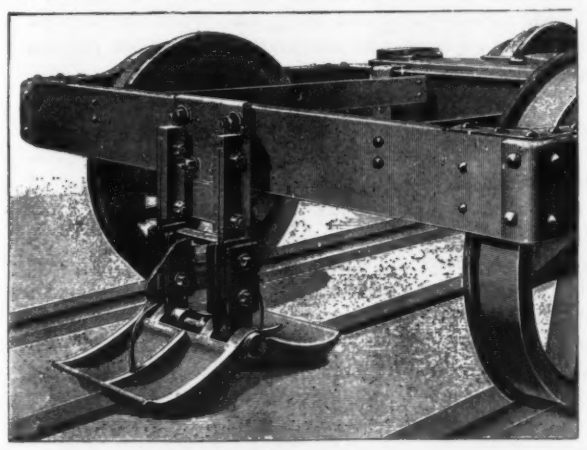


THE E P. S COMPANY'S CLAW GRID.

He concludes his lecture by saying that "The dreams of the past years and the toys of yesterday are fast becoming the hard facts of to-day."

In Paris there are 85,000 houses, only 20,000 of which are lighted by gas; the total number of incandescent lights now in use is said to be 175,000.

*Short Break Fuse.*—The Lond. "Electrician" describes the following fuse devised by Messrs. Watson & Mordey, the object of which is to obtain in a small compass a fuse for high tension circuits which will not arc. After mentioning the difficulties encountered in preventing an arc from following a blown fuse, they say that while the apparatus now generally in use may be effective, it is too large to be placed in a boxed-in transformer. The present device consists of two fuses, one a simple wire fuse, and the other a fine wire placed in shunt to the

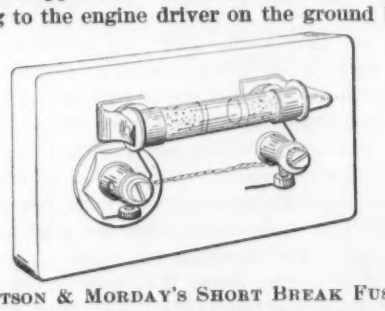


THE LIVERPOOL OVERHEAD RAILWAY CURRENT COLLECTOR.

other; the latter fuses immediately after the former, but the arc is at once killed by the action of a non-conducting powder packed in a glass tube, through which the fine wire passes. Mr. Mordey states that he has never succeeded in forcing an arc through one of these tubes, which he claims could be even as short as one inch if necessary. The arrangement is shown in the accompanying figure.

TELEGRAPHY, TELEPHONY AND SIGNALING.

*Telephone in Mines.*—Mr. Marsh, in the Lond. "Elec. Eng.," Feb. 3, describes a new use of the telephone in mines, accompanying the same by well selected illustrations of the apparatus. Difficulty has been experienced in signaling to the engine driver on the ground by means



WATSON & MORDAY'S SHORT BREAK FUSE.

of electric bells from the interior of a mine in which endless hauling ropes are used, for the reason that any of the workmen can give the signal for starting, which may cause serious damage if repairs are being made on the cable; no code of signals was found to overcome this difficulty. It is necessary that only one man be able to give the signal to start, while any one may give the signal to stop. To accomplish this he uses the telephone for the starting signal and an electric bell for the stopping signal. Only one man in the mine carries the transmitter. This not only makes mistaking signals impossible, but it also has the advantage of affording a means of communication which may in many cases, as, for instance, in accidents, be of great value. The telephone used in the mine is carried in a leather bag and will go into a vest pocket; it weighs less than half a pound. A special switch is required at the generating station, which he illustrates in his article.

*Lighthouse Signaling.*—An abstract of the first report of the British Commission on Electrical Communication with Lighthouses may be found in the Lond. "Electrician," Feb. 3, p. 396. It is of local rather than of technical interest, but the recommendations made therein show the probable feasibility of such communication. It may be of interest to mention that they recommend connecting one lighthouse without a continuous cable by the methods which were experimented with some months ago.

ELECTRO-CHEMISTRY.

*Electrical Generators for Chemical Laboratories.*—Discussing the subject of generators in chemical laboratories, the Lond. "Electrician" says: "Primary batteries are out of the question; a thermo-electric battery by itself is not sufficient, but joining it with storage cells a very simple and practical generator is obtained." Such a one is described by Dr. Erbs in the "Chem. Zeitung." There are eight small accumulators of eight ampere-hours each, and a Guelcher thermo-electric battery of 66 elements; the accumulators may be grouped in any way desired; a resistance box from two ohms down to 0.1 ohm, a Gaugain galvanometer and a commutator are also provided. The thermo-electric battery is heated by gas and needs no governor; its mean voltage is 4.1 and its internal resistance is .68 ohm; the gas consumption is 170 to 180 litres per hour; each accumulator contains one positive and two negative plates and about a quart of acid; it has a mean voltage of 2.05, an internal resistance of .05 ohm and a maximum current of three amperes. Work of the most varied character can thus be done; the accumulators are connected in parallel for charging, which can be effected in 30 hours; if kept clean they are said to retain their charge for months; chemical fumes are said not to affect the battery. (We would not like to indorse this statement for chlorine fumes.) This arrangement is said to have worked very satisfactorily in a laboratory in Freiburg.

*Accumulators.*—The Electric Power Storage Company (England) have adopted the "claw" grid shown in the accompanying cut for their negative plates (we believe they still adhere to the old method of designating the plates, and that probably they mean what in other countries is called the positive plate). The peculiar construction enables a large pellet of active material to be used with largely increased conducting surface. The peculiar claw-shaped arrangement is said to insure that the pellets are held firmly in their position, while it is claimed they have perfect freedom to expand or contract.

*Purification of Sewage.*—In a lecture before a sanitary association in Manchester it was stated that there were three processes of treating sewage in precipitation tanks—the lime process, the international process and the electrical process. The latter has been in operation at Salford, giving most satisfactory results, but the cost at present prevented its general adoption. If worked with a refuse destructor, in which the heat is utilized for generating electricity, it might be found more economical than the other processes.

*Purification of Mercury.*—Mr. Jaeger, in the "Wied. Annalen," No. 1, describes the process of purifying mercury adopted in Germany for very accurate work. After filtering and drying, the mercury is twice distilled in vacuo, during which care must be taken to avoid every trace of grease; therefore, all stopcocks are replaced by mercury seals. It is then purified by electrolysis, the liquid used being a solution of mercurous nitrate obtained by the action of nitric acid on an excess of mercury.

*Bleaching Starch.*—It is reported in England that the purification of the second and lower qualities of starch by electrolytic bleaching has been so successful that the purified starch is sold for even a higher price than the first quality, and the enterprising manufacturer who adopted the process has paid for the electric apparatus three times over within one year by the gains effected.—Lond. "Elec. Eng."

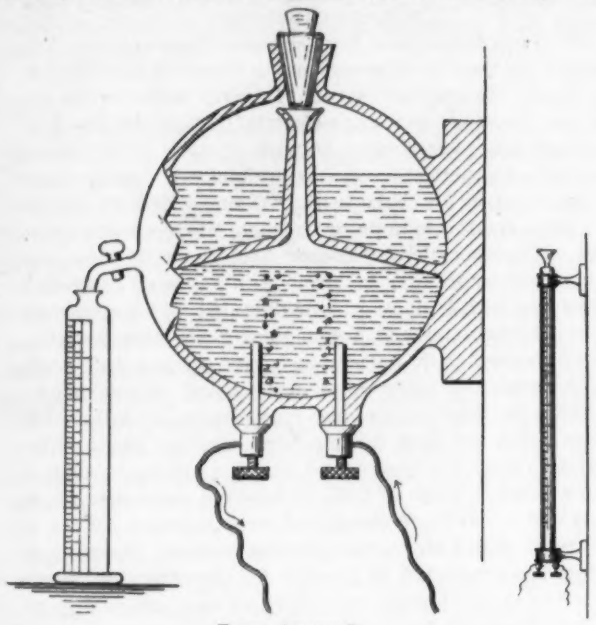
## Practical Applied Science.

A London daily paper states, though not in these words, that the British House of Lords was so dirty that after cleaning it the electric lights which were in use produced such a dazzling effect as to necessitate reducing their number! Had a practical American janitor been consulted before the plant was installed he would probably have suggested to first try the effect of soap and water and a few scrub women and painters, even if only as a matter of economy, instead of installing a large plant and then reducing it after the scrubbing process. Perhaps this more economical process also suggested itself to the English engineer who installed the plant, but he may have thought it to be to his interest not to suggest it to the authorities.

## Suggestions for Metering Devices.—IV.

BY S. D. MOTT.

The measurement of electrical energy consumed on a working circuit supplying light, heat or power by actual cubic feet, by veritable pounds, gallons or yards, may have a strangely novel and practical sound, especially to those unfamiliar with the general principles of electrotechnics. The writer has undertaken to show, in a simple and practical manner, by apparatus the non-technical can readily understand, that the foot rule, the pint measure, the every day weighing scale or the druggist's glass may serve the unique purpose of showing the consumer of electrical energy the amount of that imponderable, intangible, unseeable and unknowable commodity he



FIGS. 1 AND 2.

may be using, and with as great a degree of accuracy as will be experienced with the commercial electric meters in use at the present time.

It will be borne in mind that these inventions are suggestions, which may be variously modified, and the principles involved may be carried out in other ways.

The wonderful chemical powers of the electric current, known as electrolytic actions, were discovered and described by Nicholson and Carlisle in the year 1800. Water was the first compound decomposed; that is, resolved into its components, oxygen and hydrogen gases. In 1806 Davy delivered his celebrated lecture before the Royal Society "On Some Chemical Agencies of Electricity," and in 1807 he announced the grand discovery of the decomposition of the fixed alkalies. The researches of Faraday were given to the world between the years 1831 and 1840; in these he records that by a series of experiments with different sized electrodes, with acid solutions of various degrees of strength, and with currents of varying degrees of intensity, it was proved—

"That water, when subjected to the influence of the electric current, is decomposed in quantity exactly pro-

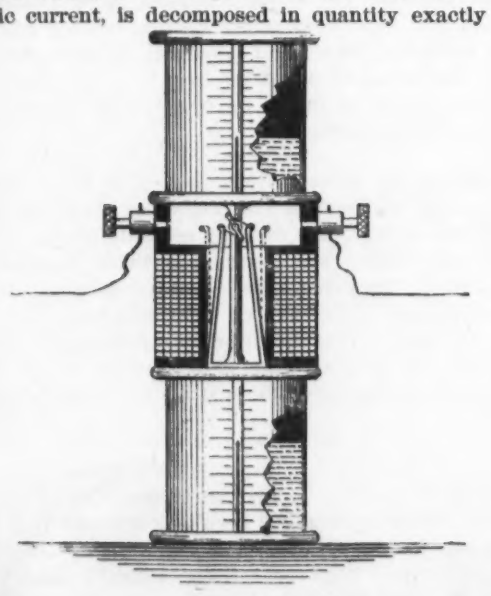


FIG. 3

portional to the quantity of electricity which passes through it, whatever may be the conditions and circumstances under which it be placed."

Assuming this phenomenon to be a fixed law, and it is known as such at the present time, it is evident that with properly disposed apparatus for the decomposition of acidulated water the volume of the mixed gases evolved by the electrolysis is exactly proportional to the amount of current consumed in effecting the decomposition; hence, also by converse reasoning, the volume of water remaining, after being subjected to decomposition by currents of varying strength flowing for a given time, will also be exactly proportional to the current consumed in effecting the electrolysis.

Referring to Figs. 1 and 2 the former measures the volume of gases evolved and the latter measures the amount of water remaining after a certain amount of it has been decomposed; in other words, the residue of an electrolyte after subjection to electrolysis.

Fig. 1 is a spherical glass receptacle divided into two chambers with a gas duct leading from the lower chamber and terminating immediately under the stopper. To prepare for recording, the cock on the left is turned off, the stopper withdrawn and the vessel filled with acidulated water; the stopper is then replaced, and the cock on the left turned open over anw measuring vessel. It is now evident that no water will flow therefrom, because of the lack of vent, but when the current circulates the gases evolved will seek the upper chamber and allow a displacement of fluid therefrom equal to their combined volume. The outflow of water at the spigot will continue so long as current flows, and to a greater or less extent, according to the current strength as per the above law. By another arrangement of apparatus the flow of fluid may be measured in volume by a form of water meter connected to the ordinary register, making it direct reading by registration on an ordinary dial.

In Fig. 2 the acidulated water is contained in a vertical graduated glass tube, open at the top for the exit of the gases and their dissipation into the atmosphere. To prevent evaporation a little oil may be admitted to the tubes. The platinum electrodes, as shown, are introduced at the bottom. The tube is graduated to a standard calibration. A simple and inexpensive form of meter is shown in Fig. 3, which consists of two communicating vessels, one above the other, containing a fluid sufficient to fill one vessel, and which will be limpid under all degrees of ordinary temperature. Alcohol would meet the requirements very well. The vessel may be made of glass with a scale marked upon its surface, or of opaque material with a graduated glass gauge, which will show clearly the height of the fluid contents.

The communicating tube between the vessels contains a cock, surrounding this tube for three-quarters of its length or thereabouts, and located between the vessels is a solenoidal coil, shown in section.

Within the core space of coil is located a bifurcated core of magnetic material, preferably soft iron, the legs of which point upward and are connected to stop cock in such a way as to vary the opening through it. During the absence of current the core is inert and the cock is closed, as shown in full lines, and when the legs of the core are separated to the maximum by full current strength the cock is open to its fullest extent, as is indicated in dotted lines. After each reading the meter is turned upside down for the alchohol to flow to the upper vessel, or it may be forced back by any suitable means. The explanation for the spreading apart of the legs of the bifurcated core under the influence of current as described is due to the well known tendency of any free magnetizable material in the core space of a magnetic solenoid to place its length in the path of the lines of force.

There is another purely magnetic reason for the expanding tendency of the legs of the core, and that is the mutual repulsion of consequent magnetic poles; but this force is only apparent when the similar poles lie in close proximity. The cock should be as frictionless as possible. It may be actuated by many other forms of electric devices than the one here shown. Normally the fluid is all contained in the upper chamber, the magnet being then energized the fluid is permitted to gravitate to the lower chamber, and this flow, in a given time, will be proportional to the energizing current, and will totalize the electric quantity flowing through the meter.

The meter illustrated in Figs. 4 and 5 is a peculiar type, and was originally carried out by the writer in a way which I understand has been devised by others, and may be briefly described as a cone having a constant motion in its axis, and the winding upon its surface of a thread between the greater and lesser diameters, the variation of shift being determined electrically.

The arrangement here presented—one of several the writer has devised—is similar in principle but differs widely as to detail. It may be described as an expanding and contracting spindle, disposed in a vertical position and rotated on its axis by a clock work mechanism seen at the top of the figure. Thread or cord is reeled from one spool, which has a slight tension, and wound upon a take-up spool by the motion of the spindle. The mechanical action of expansion and contraction, I take it, is clearly shown. The normal position of the arms revolving in the direction indicated by the arrows is that shown in dotted lines. The position of the arms determining the size of the circle which they describe is regulated by the Foucault disc moving in the varying field or fields of force of one or more magnets properly disposed.

The drag on the disc, caused by the circulating current to be measured, acting through the worm gear and against the barrel spring, causes the arms to describe a circle of greater or less circumference—depending upon the degree of drag upon the disc, which in turn is the measure of the magnetic strength of the energizing current. This device is susceptible of various modifications. I have employed it in metering devices with moving aero planes or vanes immersed in fluids. A certain amount of variation in range of arms can be effected by adjusting them along their horizontal supports. A stop motion to clock is provided, which is actuated by the passing current.

The consumption of current for a given time is totalized by removing the thread from the spool on the left, measuring its length and comparing it with a previously determined standard.

## Growth of American Electrical Industries.

Ten years ago a directory of the electrical industries of the United States could have been easily comprised within the compass of a small pamphlet. In a recently issued directory,* the 724 large octavo pages of solid text required to cover the field of to-day illustrate to what an enormous extent electricity has advanced during that period.

Of the great factors involved, telegraphy and tele-

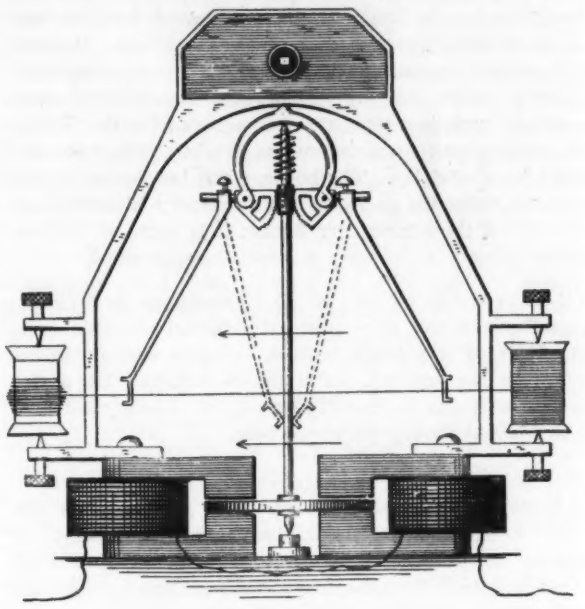


FIG. 4.

phony may be considered to have reached, perhaps, normal proportions; but in the distribution of electric light and power and in electric traction, the present expansion is merely an index of what the future has in store. A glance through the pages of the directory shows, for instance, that the transmission of power to a distance is at present confined to the section on electric mining plants; while this branch will undoubtedly become one of vast importance in the future. Another indication is the list occupying 17 pages, and including over 500 new incorporations that will soon be ushered into the active field.

The list of Central Electric Light Stations shows that there are now more than 1,850 cities and towns in the United States supplied, and the comparatively even distribution is a further indication that the growth in electric lighting is a natural one, independent of local circumstances. It is interesting to note that Pennsylvania takes the lead with 150 towns, New York and Illinois following with 147 and 133, respectively, and that in the first State there are no less than 32 new corporations, which have not yet commenced business.

The list of Isolated Plants contains information of several thousand installations, from which we learn that, aside from public and other large buildings, the electric light is in particular demand by manufacturers of textiles. It is merely a question of time when all manufactories

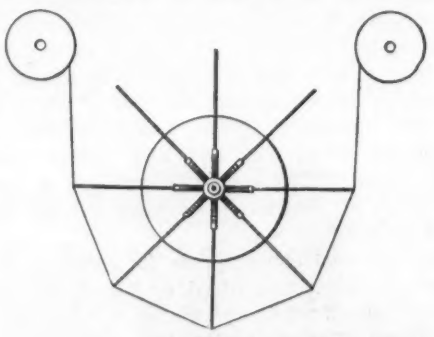


FIG. 5.

having power and using fifty or more lights will supply themselves with the electric light, so that the expansion in this direction will be enormous.

The immense amount of money invested in electric street railways is evidenced by the list of over 500 roads now using electric power. A measure of the extension of this branch is afforded by the accompanying list of horse railways, most of which may be expected to give way to the new power, and by a list of over 200 new electric railway incorporations.

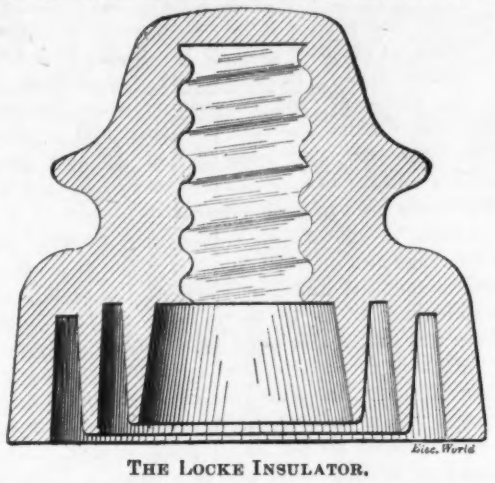
With the great demand for electrical material implied by the above survey, the extensive list of manufacturers of various electrical apparatus and supplies will not, perhaps, excite the surprise it otherwise would. To mention only two branches, there are more than 50 firms engaged in the manufacture of dynamos and a dozen carbon manufacturers.

*Johnston's Electrical and Street Railway Directory. New York: The W. J. Johnston Co., Ltd., 41 Park Row. Annual. Price, $5.

### The Locke Insulator and Pin.

Insulators and insulator pins play an important part in every installation. It is necessary that they should be cheap, simple, durable, of high insulating qualities, and easy to handle and adjust. In the manufacture of such large numbers the tendency is often toward cheapness and careless construction, but it is evident that a high grade of mechanical construction is important.

Fred. M. Locke & Co., of Victor, N. Y., are the manu-



THE LOCKE INSULATOR.

facturers of an insulator pin and insulator that are claimed to possess all these qualities, and to meet the severe requirements of practice in a highly satisfactory manner. Several thousand of them have already been put out and with excellent results.

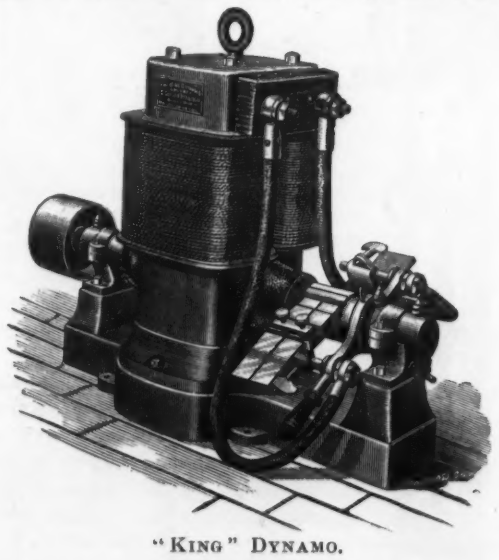
The insulator pin is forged from sheet steel, giving a compact and strong construction. The head of the pin, over which the glass insulator is screwed, is covered with an insulating sleeve, which is always in position and thoroughly protected from moisture and the effects of the weather. The portion of the pin that passes through the cross-arm is as small as is consistent with the necessary strength, and this does not weaken the cross-arm as wooden pins so often do. A metallic sleeve on the pin fits against the cross-arm, covering the hole and protecting it from moisture, and thus preventing decay, while at the same time it acts as a brace. This pin will stand a strain of 2,000 lbs. when set on hard pine cross-arms, whereas the oak pin will break at about 700 lbs.

The new patent triple petticoat glass insulator is shown in the accompanying illustrations. This insulator is very solid in its construction, and presents a very high insulating surface. Its use is especially recommended while leakage is an important item to be considered.

### The "King" Dynamo for Electroplating and Electrotyping.

The latest improved "King" dynamo for electroplating, electrotyping and copper refining is manufactured by the Detroit Dynamo Company, of Detroit, Mich. The old type of this machine met with marked success, over 200 of them being in use in this country. The new machine contains many improvements, having self-oiling bearings and a zinc sub-base between the pole pieces and the iron base. The commutator, which is made of the Eureka Tempered Copper Company's segments, is screwed on, so that instead of having to return the entire armature to the works a commutator can be forwarded, the old one removed and a new one replaced in a few minutes.

There is no reversing of current, thereby spoiling entire pieces of work, or sparking on the commutator, when the brushes are properly adjusted, or detrimental heating of fields or armature. The dynamo generates



"KING" DYNAMO.

and holds a perfectly steady voltage, whether running with a light load or loaded to its full capacity. It generates a powerful, steady, low-tension current, thereby producing a fine quality and not burning the work, depositing the metal more quickly and smoother than other machines. It is claimed the metal put on by this system is not so hard to buff, and makes a more lasting deposit, besides buffing up with a fine, rich color. For electrotyping the capabilities of these machines are gauged by the number of square feet of copper they are desired to run. They deposit a good shell in two hours.

### The Mosher Arc Lamp for Incandescent Circuits.

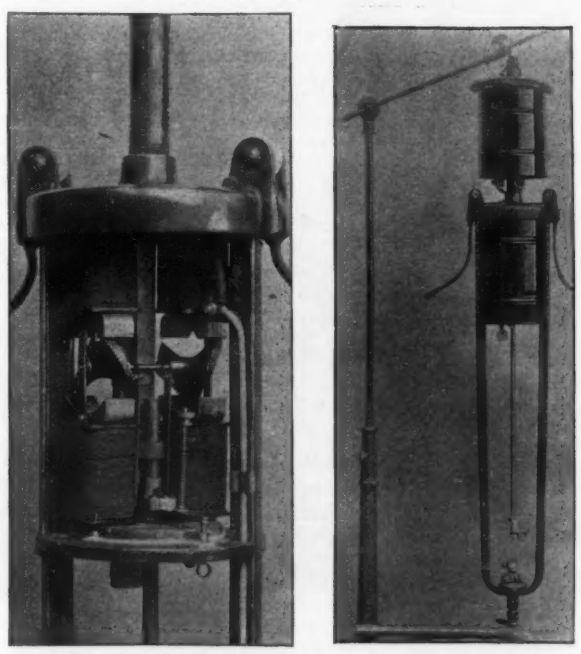
The Mosher arc lamp as now constructed possesses many novel and economical features. In its construction both clutch and clock feed is used, the former for multiple arc and the latter for series work, a feeding mechanism commended by its simplicity.

In Fig. 1 an interior view of the new alternating lamp is given. No extra resistance is required with this lamp. It is wound for from 50 to 55 volts. It will be noticed that the carbon in this lamp is controlled with a rotary motion, as is explained by the cut. All connections are made in such a way, and all wearing parts are so constructed, that the natural wear is taken up automatically, and therefore they can never rattle or "sing," a feature so objectionable in all alternating arc lamps.

The Mosher railway circuit arc lamp is constructed mainly for use on railway circuits, and can be made to operate from 5 to 10 in series on a 500 volt circuit. These lamps are constructed with a rack feed, and are wound to vary from 6 to 10 amperes, according to the light desired. The feeding mechanism is controlled by separate magnets, one shunt, and one main circuit, which releases the escapement and allows the lamp to feed only when the arc has passed beyond, or attempts to feed only when its proportionate share of the voltage of the system on which the lamp is run. The main circuit magnet is wound in such a relation to the derived circuit that when the lamp is regulated for certain amperage it will be impossible for the amperage to vary very much from the amount of amperage for which the lamp is regulated.

Fig. 2 shows a series of single clock feed lamp for use on direct current circuits.

The following results of a test are of interest: Length



FIGS. 1 AND 2.—THE MOSHER ARC LAMP.

of test, four hours; amount of current, six and one-half amperes; voltage, 110; two lamps in series, voltage of the dynamo varying from 95 to 115; least number of times lamp fed per minute, three; greatest number of times lamp fed per minute, five; greatest distance fed at any one time, a fraction more than 5-1000ths of an inch; carbon used, five-eighths low tension; voltage for each arc, 50; with total voltage 110, showing about two ohms of idle resistance.

These lamps are manufactured by the Mosher Electric Company, 125-127 East Ontario street, Chicago, Ill.

### Adjustable Electrolier.

The accompanying illustration represents something new in the line of an adjuster for raising or lowering incandescent lamps suspended on cords. It differs essentially from other devices for this purpose in the fact that the regulating device is attached permanently to the ceiling, taking the place of a ceiling rosette or cut-out. The cord is, therefore, not rendered clumsy by a heavy adjusting ball, and the movement up and down is more readily controlled and more certain. In appearance, the adjustable electrolier is very neat, resembling a polished brass canopy. It is thoroughly constructed in every detail, simple in design and not likely to get out of order, as is sometimes the case with carelessly constructed apparatus.

The Electric Appliance Company, of Chicago, is looking after the interests of this new device in the West with gratifying success, and looks forward to a general demand for such a useful contrivance.

### Ball Tandem Compound Engine.

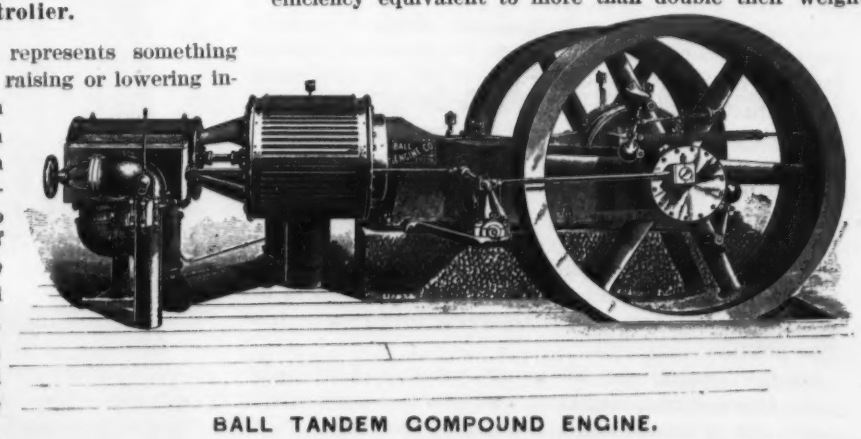
This engine is an outgrowth of the experience of this company in the manufacture of engines of smaller capacity, adapted to the work of driving street railway generators—the demands from this service for economical motive power within small space and safety of operation

ADJUSTABLE ELECTROLIER.

being such that this type of engine is now found to be a winning competitor with single cylinder Corliss engines of 28×48 inches to 26×60 inches cylinder capacity and wheel diameter of 20 feet. In this engine the stroke is made short for the purpose of raising the number of revolutions and reducing the wheel diameters so as to more nearly approach the diameters of the generator pulleys, giving better belt contact. The range of wheel diameters is from 80 to 112 inches, which enables the engine to drive directly on to the pulleys of the different makes of generators without the intervention of line shafts or other devices for raising the lineal velocity of the belts, this being accomplished within economical ranges of piston speed (i. e., 600 to 700 feet per minute) and perfectly reasonable as well as economical steam pressure (i. e., 100 to 115 pounds).

The engine herewith illustrated is one of several which have been put in operation within the past year. It is perfectly balanced, and does not require the enormous foundation which its slow speed competitor is obliged to have, one of them giving the most satisfactory results at a speed of 210 revolutions on a pier of its own length, 17 feet high, piercing a comparatively light engine room floor, 14 feet pitch from the basement floor, on which is located all of the steam plant outfit other than the engines and dynamos. This engine is endowed with great strength, rigidity and long living powers, owing to the form of the frame, shaft, cylinders, heads and reciprocating parts, the latter, with the exception of the pistons and wrist pin boxes, being of forged steel from tip to tip. The shaft is of one solid piece of forged steel of a grade that is most excellent for the purpose. The high pressure valve motion is derived from the governor, while the low pressure valve is driven by direct connection from an eccentric on the other side of the engine, this eccentric being adjustable. The valves, of the "nearly" balanced type, are absolutely steam tight, and will remain so indefinitely, as the wear is so trifling that a few hours of scraping will renew the faces as good as when first started, after two or three years' run of 10 to 18 hours per day. The general features of the engine are suggestive of correct location and distribution of the parts and materials involved.

The engine shown has 18-inch high pressure and 30-inch low pressure cylinders, with 18-inch stroke pistons, carries two wheels of 96 inches diameter by 25-inch face, weighing 10,000 pounds each, giving a fly wheel capacity and efficiency equivalent to more than double their weight

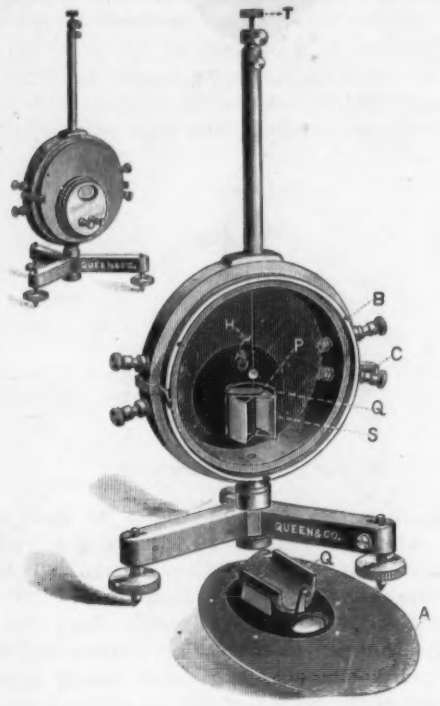


BALL TANDEM COMPOUND ENGINE.

if made into a 20-foot wheel for a 60-inch stroke engine making under one-third as many revolutions. It is being demonstrated in this plant that with a regulation giving an increase of speed of one per cent from empty generators to full capacity (i. e., 350 kilowatts) that the voltage taken at 480 when no current is being used will follow the increase of engine speed almost exactly up to the maximum of 500 for full load.

### New Queen Measuring Instruments of Precision.

Queen & Co., Incorporated, of Philadelphia, have recently put upon the market some electrical measuring instruments, two of which are shown in the accompanying illustrations. Fig. 1 shows this new form of D'Arsonval galvanometer. The magnet is horizontal, circular in form, and built up of a number of discs stamped from sheet steel. The pole faces are shaped so as to give readings on a straight scale exactly proportional to the currents measured. The coil is long, narrow and circular in cross-section, and is fastened in an aluminium tube, which forms part of the movable system. No iron core is used. The suspension tube is fitted with a movable bottom, which, when raised, lifts the coil so as to relieve the suspension, and clamp it tight. This prevents any injury during transportation. The whole suspension tube can be lifted out and replaced by another, automatic sliding contacts being made as the tube is put in position. To use the instrument all that is necessary is to lower the bottom gently and relieve the coil. The mirror is so arranged that the axis of rotation lies in the centre of reflecting plane, and the window of the mirror cage is silted to prevent reflection from its surface. The instrument is sensitive to a high degree, and, being absolutely uninfluenced by strong and varying fields or mechanical vibrations, gives as accurate results when used in a dynamo room as when used on a brick pier in a laboratory. For general use, the motion is made absolutely dead beat, so as to obviate the necessity of using "tapper keys" and to save an enormous amount of time. Tubes are also made for ballistic work, in which the damping effect is lessened, and in this connection a bifilar suspension has been used. With two suspensions of .0015 inch, phosphor-bronze strips 20 inches long and 3-32 inch apart and a coil of 703 turns of No. 40 copper wire, whose resistance is 450 ohms, a throw of 25½ centimetres with one microfarad and one Carhart cell and a period of 10 seconds was obtained. When used as a ballistic galvanometer, the coil, on being thrown to the end of the scale, may in every case be brought completely to rest in from 12 to 15 seconds by merely short-circuiting. The instrument can also be used for thermal work.



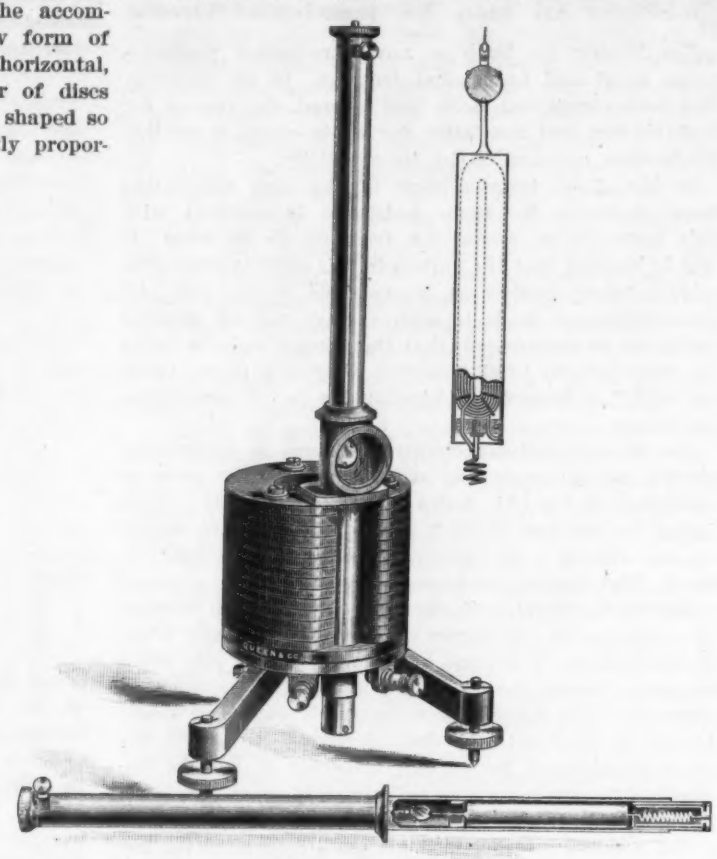

FIGS. 1 AND 2.—QUEEN'S MEASURING INSTRUMENTS.

Fig. 2 represents the Ryan electrometer. This instrument was designed by Prof. Harris J. Ryan, of Cornell University, for measuring potential difference, either direct or alternating. The quadrants, four in number, are mounted on two quartz discs, set on the inside of two metal cover plates that protect the system, and faced with mica to prevent short-circuiting, should the needle happen to touch them. The needle is cylindrical in shape, and can be hung with either quartz or silk suspension. It is situated exactly in the centre of the cover case, and just above it is fastened the mirror whose silvered surface contains the axis of rotation. The cover case is made of two parts symmetrically disposed with respect to the system, and held in position by a spring clip. In this way both parts, each carrying a pair of quadrants, can be lifted from the frame so that the needle may be inspected. Three little pegs, over which each half of the cover plate fits, insure their returning to the same relative position.

On the circumference of the cover case, and symmetrically disposed with respect to the system, are two wound coils, one of coarse and the other of fine wire. These enable the instrument to be used in two ways. Either the E. M. F. may be calculated from the deflection it produces, this being measured by a scale and telescope, or else a zero method may be used, in which the needle is brought back to zero, after being deflected by the action of a current passed through the wound coils mentioned above, and the E. M. F. calculated from the magnitude of this current. This latter has the advantage of giving results unaffected by changes in the earth's field.

### The Valley Duplex Steam Pump.

The duplex steam pump herewith shown is built by the Valley Pump Company, at Easthampton, Mass. This company began the manufacture of steam pumps in 1865 by bringing out the Wright bucket plungers from designs furnished by the patentee, Wm. Wright, of Newburgh, N. Y., and it has obtained a reputation for first class work. Its duplex pump differs from others in the market in the manner of moving the steam valves, which is much preferable to the "link" used by other makers, and was designed and patented by John Mayher, who has been the manager of this company from the beginning. The pump is thoroughly constructed in every particular, and has worked with entire success under the varied conditions of practice.



THE VALLEY DUPLEX STEAM PUMP.

### E. W. Bliss Company's Armature Cutting Press.

The cut illustrates a press for blanking out large armature discs, as recently built by the E. W. Bliss Company, 12 Adams street, Brooklyn, for the Edison General Electric Company, the Thomson-Houston Electric Company, the Curtiss Electric Company and a number of other concerns. The construction of this press embodies a number of special features which have not heretofore been used in connection with presses of this class.

In order to give a firm support and accurate guidance to the large and delicate dies, the ordinary centre gib has been abandoned and the ways of the slide have been spread apart so as to be as wide as the frame itself. These ways have also been considerably lengthened, adding much to the solidity and accuracy of the machine.

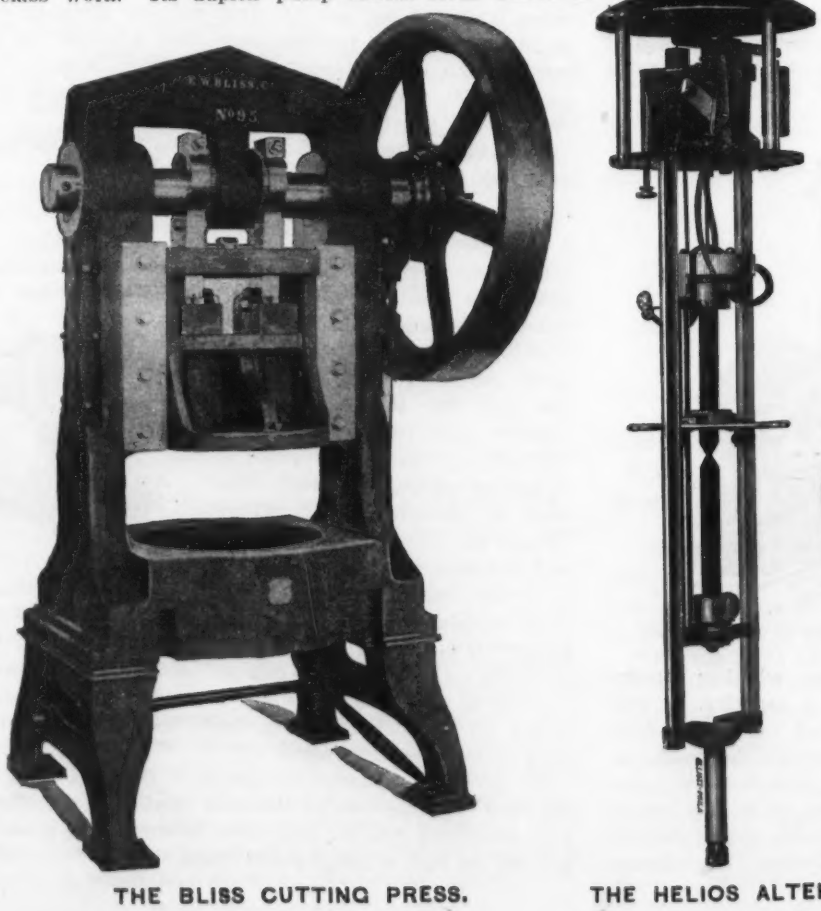
For adjusting the slide, the Stiles eccentric adjustment is used, which enables the operator to quickly raise and lower the slide to the exact point desired without any danger of getting same out of alignment. The pressure with this adjustment is always on solid metal instead of screw threads. As regularly made, this machine has 32 inches between uprights and the bed is furnished with a 24-inch round opening, but it is sometimes also made with 40 inches between uprights and with 30-inch hole. The weight is approximately 9,400 pounds.

### The Helios Alternating Current Arc Lamp.

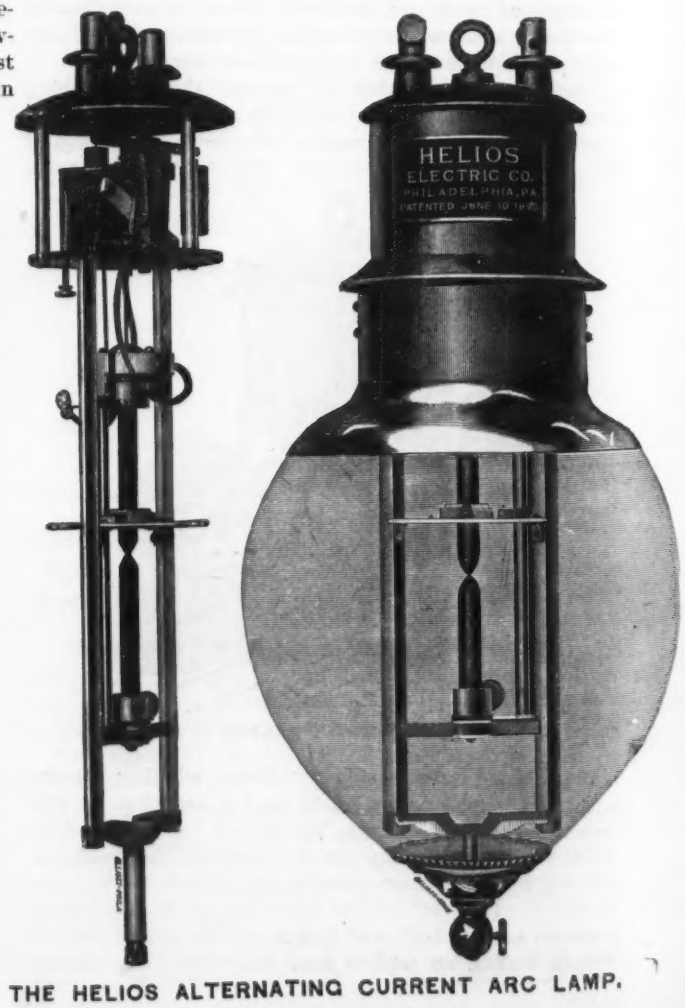
The Helios arc lamp is the ingenious invention of Carl Coerper, of Ehrenfeld, Germany. With some minor improvements made by this company, it is exclusively controlled in America by the Helios Electric Company of Pennsylvania.

Fig. 1 shows the lamp with globe and cap removed. The construction and operation involve the most simple mechanism. As will be seen, the lower carbon holder is attached to a chain which is carried over a pulley in the lamp mechanism, the other end being attached to the upper carbon holder. The result of this arrangement is, that as the lower carbon ascends, the upper carbon descends, and exactly in the same ratio. The arc is thus fixed at a given point and remains stationary from the time the current is turned on until the carbons are consumed.

As is well known, the alternating arc forms a crater both in the upper and lower carbon, so that considerable light is emitted by the crater of the lower carbon, which is thrown upward and thus generally wasted. This has been overcome by placing, about one-half inch above the arc,




THE BLISS CUTTING PRESS.




THE HELIOS ALTERNATING CURRENT ARC LAMP.

a white enameled reflector, which throws down all the light emitted from the lower carbon, increasing the illuminating power at least 40 per cent.

The regulation is effected entirely by a single solenoid coil, the feed of the carbon being controlled by a lever which presses against the periphery of a friction wheel included in the releasing train. By this means a feed of 1-1000th of an inch is made possible. The upper carbon holder is made so as to slightly overbalance the lower carbon holder. The result is that the work of the solenoid coil and mechanism is restricted simply to the small weight representing the difference between the carbon holders. A free piston dash serves to steady the movement of the regulating mechanism.

Fig. 2 shows the 7-hour lamp complete, with globe, ready for use. The length of the 7-hour lamp is 25½ inches over all; the 12-hour lamp, 32 inches. The single carbon principle is used exclusively, thereby avoiding the awkward complication found in double carbon lamps.

One of the advantages of this lamp is the low tension employed. It is intended for use either on the ordinary 50 volt secondary circuit or with a special transformer on a 30 volt circuit. All danger is then obviated. Either one Helios lamp or two in series may be placed across the mains, and a material saving in watt consumption over direct current arc lamps is claimed. In addition to safety and economy, the following advantages are claimed: Superior mechanical and electrical construction; absolute freedom from flicker; simplicity; brilliancy and whiteness of light; the current consumed can be measured by a meter. It is stated that over 30,000 Helios arc lamps are in daily use in Europe.

# Financial Intelligence.

## THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Feb. 23, 1893.

NEW YORK GENERAL FINANCIAL STOCK MARKET.

**In General.**—The market of this week thus far has been a repetition of the events of last. In addition, it can be said to have possessed more aggravated bearish tendencies and pessimistic types. The downward movement which started about ten days ago received impetus after impetus, until it would seem as if values had reached about the lowest point possible on the safe side of a small sized panic. The conditions which have contributed to this movement are very clearly defined and easily set forth. The primary cause is to be found in the continued gold exports, and the persistent refusal of the present administration to issue bonds for the relief of the United States Treasury. These two factors in themselves could not be considered as warranting the heavy load of suspicion which was dumped upon Wall street. Nevertheless, sentiment in this world of Mammon is often worse than reality. The first effect was to drive the general public out of the market; second, to cause a covering of stocks; and the third, and perhaps the most potent, was the creation of an aggressive bear interest which proceeded to monopolize affairs to its profit and a decided decrease in values. Ten days ago the industrial stocks were the favorite objects of attack. After a number of these had been worked to a lower basis, attention of the bear contingent was directed toward Reading, with its great overload of debt and its poor financiering. There could have been but one result. This is to be summed up in a few words. The stock which was selling a few weeks ago in the fifties is now 28, and the road is in the hands of a receiver. The causes which led to the sudden termination of President McLeod's flighty career need not be discussed here further than to say that the receivership is so constituted as to insure a conservative attitude for Reading in the coal trade. One of the features of the market to-day was the bear raid which was made on Sugar, depressing the stock down from 123 to 115¼. It would perhaps be difficult to find any one who does not believe that the stock will eventually be carried much above its opening figure. The question is only one of time. Almost hourly there are pleasant little episodes, of which the course of Sugar is typical, indicating the feverish, panicky condition of the market. The gold situation has not improved in the least. On Tuesday we shipped $3,500,000, and on Saturday $3,000,000 more will go, with assurances that next Tuesday will chronicle additional heavy shipments. At the end of the week the Treasury reserve will not be more than $4,000,000 above the minimum of $100,000,000. Concerning the future of the market there is much to be said, a major portion of which can only be speculation. If the Sherman silver law is repealed, or the Treasury issues bonds, or both, the market will respond with a buoyancy as great as the present depression. Even should no action be taken along either of these lines, we believe that the present condition of affairs will not continue for any great length of time, as, in the logical course of events, a reaction is now about due. There is a heavy short interest in the market, which, when it becomes convinced that bottom has been reached, will start in to cover. This will invariably carry prices to a higher plane. Just at the present time the market is a good thing for the margin trader to let alone.

NEW YORK ELECTRICAL STOCK MARKET.

**This market** has been almost featureless, owing to causes set forth preceding. Transactions were very light and at declining values. There was scarcely any inquiry for bonds, and only a few odd lots were sold. Brokers dealing in electrical specialties report it almost impossible to interest capitalists. They predict that affairs financial must become decidedly more settled before prospects are brightened. Of the more active stocks not mentioned we quote American District Telegraph, 55 to 56½, a loss of about three points; American Telegraph and Cable at 88 to 89, a loss of from three to four points. There is no particular reason be ascribed for this decline; both stocks are "dirt cheap" at these figures, and will be quick to rally in an upward movement. North American ranged from 9⅛ to 9⅝ on limited sales and an indifferent market. This was about its record of last week.

**General Electric** opened the week fairly strong at 109, which is a drop of about a point as compared with the closing of last week. It will be remembered that the decision of the Boston court in the incandescent lamp matter, which reached the Exchange on Saturday, was responsible for a two-point advance. However, the condition of the market was not sufficiently stable to warrant these higher figures, and the stock sold off steadily until 107 was reached to-day. The bonds reached the lowest point at which they have ever sold. They were underwritten at par and sold as high as 105¾. On Monday they touched 98⅝. We learn from competent authority that President Coffin, of this company, has not resigned his office to take the presidency of the New England Street Railway Company. It is stated positively that Mr. Coffin has no intention of resigning.

**Chicago dispatches** to Eastern papers have been burdened of late with a statement that a certain large electrical company did not propose to exhibit at the World's Fair, because of some fancied or real grievance. We have a direct statement from a high officer of the General Electric Company, in effect, that the plans of the General Electric relative to the World's Fair Exhibition have not been changed in any particular; that it has prepared an extensive exhibition, and that the same, for anything which can now be foreseen, will be made according to programme. This statement also includes the exhibit of Mr. Thomas A. Edison, who is allied to the General Electric Company's interests, and who has agreed to lend his best efforts toward making the exhibit a success.

**In regard to the incandescent lamp matter** we learn that no steps have yet been taken against the Westinghouse company on the ground that its new lamp is an infringement. We understand that the General Electric Company has samples of these in its possession and is examining them for the purpose of determining whether they are an infringement, but that up to date it has reached no conclusion. Further, it is said that the Westinghouse lamp, notwithstanding the fact that it was advertised to be ready for sale on Jan. 1, is not yet on the market, and until it becomes a factor in the trade no steps will be taken against it.

**In regard to the decision of Judge Colt,** delivered in Boston, in the Beacon case, involving letters patent on the incandescent lamp injunction, we learn from high authority that the company regards this as the last step necessary to conclusively establish its claims beyond all possibility of a contention. Since the decision of the United States Court of Appeals, delivered in October, granting it the exclusive right to manufacture the incandescent lamp, the Edison company has been busily at work securing the injunctions. It has successfully brought action against the following companies: The United States Electric Light, the Sawyer Man, Westinghouse, Beacon, Columbia, Mather, Perkins, and the Illinois companies. The ground has by no means been covered. However, it is the avowed policy of the company to continue these actions until every concern making a lamp is restrained.

**Incandescent Lamp.**—A Pittsburgh special to one of the news agencies to-day says: "In the case of the Edison company against the Westinghouse Electric and Manufacturing Company, under proceedings instituted by the latter company for the purpose of determining the rights to manufacture the stopper lamp, Judge Atcheson read an opinion this morning to the effect that the question was one not to be determined on a motion for a preliminary injunction on *ex parte* affidavits at the request of the defendants, but that the difference in the construction of the lamp is such that a decision should only follow a final hearing, after the taking of testimony in the usual manner and after trial. It was also decided that the question might properly be determined in this court under pending proceedings. There is yet pending the petition of the Westinghouse Electric and Manufacturing Company asking the court to restrain the Edison company from bringing suit against customers of the Westinghouse company. When the argument on this petition will be heard has not yet been determined."

**Western Union.**—This stock slumped off stubbornly by fractional points, closing at about the opening, from 95¾ to 96½. There is no special movement to note in its course. The buying during the week was quite extensively indulged in by capitalists who only visit Wall street during panicky times A member of the Executive Committee said: "The company is making 5 per cent. on $100,000,000 capital and will continue to pay that amount on the full capitalization. The stock is more lightly held, from a speculative point of view, than ever before in its history. I think this will be acknowledged and recognized in the action of the stock during the Reading panic. Under ordinary circumstances, a break of at least ten points would have occurred, because, being active and having a ready market, it would have been sold out to protect other interests."

**Edison Electric Illuminating Company.**—The first mortgage coupons of this company, due March 1, will be paid by the New York Guaranty and Indemnity Company.

**Closing Quotations.**—The following were the closing quotations of electric stocks on Thursday, Feb. 23, 1893, and the range for the week in New York:

NEW YORK QUOTATIONS

| | Par. | Capital outstanding. | Lowest. | Highest. | Bid. | Ask'd. |
|---|---|---|---|---|---|---|
| American District Tel.... | 100 | 3,825,000 | 55 | 56½ | 53½ | 54½ |
| American Bell..... | ... | ..... | .... | .... | 203 | 203½ |
| Erie Telephone..... | .. | .... | .... | .... | 47 | 47½ |
| Mexican Telephone..... | ... | ..... | .... | .... | 85c. | 90c. |
| New York & N. J. Tele. | ... | .... | .... | .... | 96½ | 98 |
| New England Teleph'ne | . | .... | .... | .... | 58 | 58½ |
| American Tel. & Cable.. | 100 | 14,000,000 | 88 | 89 | 89¼ | 89½ |
| Central & So. Am. Tel.... | 100 | 6,500,000 | .... | .... | 110 | 112 |
| Commercial Cables..... | 100 | 7,716,000 | .... | .... | 170 | 185 |
| Gold Stock & Tel ..... | 100 | 5,000,000 | . | .... | 170 | 185 |
| Bonds..... | 500 | 500,000 | .... | .... | .... | .... |
| Franklin..... | 100 | 1,000,000 | .... | .... | 38 | 42 |
| Mexican Telegraph..... | .... | 2,000,000 | .... | .... | 180 | 200 |
| Metropolitan Tel. & Telegraph Co..... | .... | ..... | .... | .... | 102 | .... |
| Northwestern Telegraph. | .... | 2 500,000 | .... | .... | 102 | 105 |
| Northwestern Tel. 7's. | .... | ..... | ... | .... | 108½ | .... |
| Postal Tel. & Cable..... | . | 10,000,000 | .. | .... | 81½ | 82½ |
| Southern & Atlantic Tel.. | 25 | 948,775 | . | .... | 78 | 80 |
| Western Union Tel... ... | 100 | 94.820 000 | 95⅝ | 96⅛ | 95⅛ | 95¾ |
| Real estate bonds... .. | 1,000 | 1,219,000 | .... | .... | .... | .... |
| Debenture 7's, 1875-1900. | 1,000 | 1,920,000 | .... | .... | .... | .... |
| Collateral Trust 5's.... | 1,0.0 | 8,181,000 | 104¾ | 105 | 104¾ | 105 |
| North American..... | 100 | 39,767,200 | 9⅛ | 9⅞ | 9½ | 9⅝ |
| Brush Ill. Co, common .. | 50 | 1,000,000 | .... | .... | 25 | 30 |
| Edison El. Ill. of N. Y..... | 100 | 6,100,000 | 123 | 125½ | .... | ... |
| " " 1sts ..... | ... | ... .... | 123¾ | 123¾ | ... | .... |
| " " Deb's.... ... | | | .... | .... | ... | .... |
| Edison El Ill. of Brooklyn. | 100 | 1,500,000 | | .... | 120 | 125 |
| " " " " Chicago.. | 100 | 750,000 | ... | .... | 170 | 180 |
| " " " " Boston... | ... | ..... | .... | .... | 142 | 150 |
| " " " " Phila... | .... | ..... | .... | .... | 130 | 131 |
| Edison El. Lt. Europe....1,000 | | 2,000,000 | .... | .... | 2 | 6 |
| " Bonds..... | ... | 30,000 | .... | .... | 80 | 85 |
| Edison Ore Milling Co.... | ... | 2,000,000 | .... | .... | 12 | 17 |
| East River El. Light..... | 100 | 1,000,000 | .... | .... | .... | 65 |
| Fort Wayne Electric..... | ... | ..... | .... | .... | 123¾ | 131⅛ |
| General Electric ..... | 1,000 | 30,395,600 | 107 | 109 | 107 | 107¼ |
| Debenture 5's ..... | ... | 10.000,000 | 98½ | 98½ | .... | .... |
| Automatic Exhibition Co. | ... | 2,500,000 | .... | .... | 3 | 5 |
| Interior Conduit & Ins. Co. | 100 | 1,250,000 | 64¾ | 64¾ | 63 | 66 |
| Mt. Morris Electric..... | ... | 500,000 | .... | .... | .... | 65 |
| N. E. Phonograph..... | . | 2,000,000 | .... | .... | 2 | 4 |
| N. Y. Phonograph .. | . | 2,000,000 | .... | .... | 2 | 5 |
| N. American Phonograph .. | | 2,000,000 | .... | .... | 4½ | 6 |
| Westinghouse E. & M. Co. 1st p. 7 per cent., Cum. | 50 | 3,755,700 | .... | .... | .... | .... |
| E. & M. Co. Assg..... | 50 | 5,333,940 | .... | .... | .... | .... |

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stocks furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

| Telephone Stocks: | Bid. | Ask'd. | Electrical Stocks: | Bid. | Ask'd. |
|---|---|---|---|---|---|
| Chicago..... | 190 | 194 | Chicago Arc Light and Power Co..... | 117½ | 118 |
| Central Union ..... | .... | 54½ | Chicago Edison Co .. | 220 | .... |
| Michigan..... | .... | 93 | | | |

**Dividends Payable:** American District Telegraph Company. 1¼ per cent., Feb. 21. Books open: American District Telegraph Company, Feb. 21. Books close: Postal Telegraph Company, Feb. 20.

**Brooklyn Edison Illuminating Company** stockholders will meet March 8 and consider a proposition to increase the capital stock $1,000,000, to $2,500,000.

**The Copper Market.**—The market for Lake copper is 12 cents. At this figure there are more buyers than sellers, this condition being possible owing to the very limited demand. Certain of the companies producing Lake copper, notably the Calumet & Hecla, are holding for higher figures. This last named is asking 12½ cents. It is safe to assume that it is not disposing of any stock. Certain producers, in consideration of the nearness of Lake navigation, are declining offers of 12 cents, preferring to hold their copper until it can be shipped East to tidewater at 17 cents per 100 pounds instead of 60 cents all rail rate, which now rules.

## NEW INCORPORATIONS.

**The Baltimore Avenue Railway Company,** Philadelphia, Pa., capital stock $50,000, has been formed to construct an electric railway. Wm. Jenks Fell, Mahlon M. Childs and J. E. Blessing are the incorporators.

**The Radford Electric Light and Power Company,** of Radford, Vt., capital stock $35,000, has been formed to operate an electric plant. F. L. Grofflin, E. S. Jones, C. K. Mount and W. J. Kemderdine are the promoters.

**The People's Electric Light, Power and Heating Company,** capital stock $50,000, has been formed to furnish light, heat and power. Geo. Reish, J. H. Schuck, Chas. Schuck and Chas. F. Herman are the incorporators.

**The Citizens' Railway Company of Chester County,** West Chester, Pa., has been formed to operate an electric railway. W. P. Snyder, Spring City; J. H. Baldwin and T. L. Eyre, West Chester, Pa., are the incorporators.

**The Norwalk Electric Company,** of Norwalk, O., capital stock $50,000, has been incorporated to furnish light, heat and power. W. R. Huntington, F. Colson, D. W. Vail, A. L. Osborne and Chas. Suhr are the incorporators.

**The Wilkes-Barre & North Side Railway Company,** of Wilkes-Barre, Pa., capital stock $30,000, has been formed to construct an electric railway. I. Jacobosky, P. Butler Reynolds and John B. Reynolds, are the organizers.

**The Davis Electric Light Company,** Davis, W. Va., capital stock $50,000, has been formed to erect and operate an electric plant. T. B. Davis, Keyser; H. S Buxton, Piedmont, and F. S. Landstreet, Davis, W. Va., are the promoters.

**The Harrisburg & West Side Electric Railway Company,** of Harrisburg, capital stock $100,000, has been incorporated to operate an electric railway. Chas. B. McConkey, Valentine Hummel and Geo. W. Buttorff are the promoters.

**Municipal Electric Company,** of Decatur, Ill., capital stock $25,000, has been formed to operate an electric heat and power plant and to manufacture and sell electrical appliances, etc. J. H. Culver, J. M. Willard and E E. Gibson are the promoters.

**The Wilkes-Barre & Plymouth Railway Company,** of Wilkes-Barre, Pa., capital stock $30,000, has been incorporated to build an electric railway in Luzerne county. I. Jacobosky, P. Butler Reynolds and John B. Reynolds are the promoters.

**The Philadelphia & Delaware Street Railway Company,** Chester, Pa., capital stock $150,000, has been formed to construct and operate an electric railway in Delaware county. The incorporators are G. P. Debins, D. Howarth and J. P. Ryan.

**The Electric Supply Company,** Port Huron, Mich., capital stock $5,000, has been formed to manufacture and sell electrical and other goods and merchandise. L. A. Sherman, J. H. White and Fred. W. Sherman, all of Port Huron, are the organizers

**The Philadelphia West Side Passenger Railway Company,** of Philadelphia, Pa., capital stock $250,000, has been incorporated to construct and operate an electric railway. G. F. Gibson, Jr., Geo. H. Roberts and John L. Fry are the organizers.

**The Saginaw Power Company,** of Saginaw, Mich., capital stock $50,000, has been formed to manufacture and furnish electricity for heat and light. Mr. Wm. A. Jackson, David Wallace, F. E. Snow and I. M. Nichol, of Detroit, Mich., are the organizers.

**The Columbia Water and Light Company,** Columbia, Mo., capital stock $80,000, has been formed to operate electric works, etc. W. T. Anderson, St. Louis, and R. B. Price and Irvin O. Hockaday, both of Columbia, Mo., are the interested parties.

# Special Correspondence.

## NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING. NEW YORK, Feb. 24, 1893.

**Mr. B. F. Leavitt,** of Porter & Leavitt, Providence, R. I., manufacturers of fan and battery motors, was in town last week. This company is enlarging its plant and while in New York Mr. Leavitt made large purchases of new and improved machinery.

**The Underwood Manufacturing Company,** of which C. S. Merrill is selling agent, has opened a branch office under its own management at 38 Cortlandt street, New York City, where it will carry a full line of its patent cotton leather belting and various belting specialties.

**The Evening Trade School,** 225-227 East Ninth street, New York City, will give the third of its course of lectures under the auspices of the Franklin Electrical Society on chemistry and its relation to electricity, by Mr. Julian A. Moses, to be illustrated by experiments and stereopticon views.

**The State Electric Light and Power Company,** of Brooklyn, was organized a couple of years ago, and has since been vainly trying to get a franchise from the Aldermen. President Noah L. Cocheu of the company has sent a communication to the Aldermen offering to give the city $10,000 for the franchise, and also engaging to furnish the city with light at a 10 per cent. reduction on the present rates, and to have the plant in operation within ninety days. The communication was referred to the Gas and Lamp Committee.

**Mr. John W. Mackay,** principal stockholder of the Postal Telegraph and Cable Company, and of the Commercial (Mackay-Bennett) Cable Company, was shot in front of the Lick House, San Francisco, Cal., on Friday. The injury was not serious, it being considered only a flesh wound. Mr. Mackay was fired upon from the rear by an unknown man, who is considered to be a crank. After shooting Mr. Mackay he turned his pistol upon himself, killing himself instantly.

**The Executive Committee on Awards** of the World's Columbian Commission, of which John Boyd Thacher is chairman,

has entire charge of the appointment of judges to serve during the Exposition. Each exhibit is to be examined by a competent expert, who must submit his opinion in writing as to its merits to the Departmental Committee of which he is a member. There are thirteen of these Departmental Committees, one of which is assigned to each of the thirteen great departments of the Exposition, and these thirteen committees compose the Board of Judges. There will be foreign representation upon each of these thirteen committees, and also one or more women judges upon all committees authorized to award prizes for exhibits which may be produced in whole or in part by female labor. It is the desire of the World's Columbian Commission to compensate judges, but this will depend upon the action of Congress. Should the appropriation be made, judges from the United States will receive $600 each, and those from foreign countries $1,000 each. Their work should begin June 1 and last about two months. It is desired to obtain persons of high ability and efficiency, if possible of national and international reputation, to serve as judges, and the Executive Committee on Awards desires the earnest coöperation of all engineers and those in any way interested in the subject.

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ALBANY, Feb. 23, 1893.

**The Troy Steel and Iron Company** has re-elected the old Board of Trustees with the exception that John B. Archibald was chosen in the place of the late O. B. Jennings and J. W. Cox in place of C. E. Dudley Tibbits.

**The following directors and inspectors** of the Watervliet Turnpike Railroad Company have been elected: Directors, Albert Hessberg, E. A. Groesbeck, Henry Bronk, W. R. Cassidy, W. L. Green, James M. McCredie, William Lester, F. C. Manning, Charles L. Pruyn; inspectors, Joel Rathbone, James Cooper, J. E. Griswold.

**The Railroad Commission** held a meeting recently and authorized the Third avenue street car line of New York City to increase its capital stock from five millions to seven millions, for purposes of cable connections. Action was deferred on the matter of the application of the Staten Island & Belt Line Railroad for permission to adopt the overhead electric trolley system. The commission has approved of the application of the Van Brunt Street & Erie Basin Railroad Company, of Brooklyn, for an increase of its capital stock from $150,000 to $200,000.

**The report of the Albany Railway** for the quarter ending Dec. 31, filed with the State Railroad Commission, makes the following showing:

| | 1891. | 1892. |
|---|---|---|
| Gross earnings from operations | $54,146 | $101,739 |
| Operating expenses | 30,828 | 59,264 |
| Net earnings from operations | 23,328 | 42.774 |
| Interest on funded debt | 9,081 | 9,896 |
| Taxes | 1,716 | 2.680 |
| Rentals | 140 | 7,607 |
| Net income | 13,390 | 22,290 |
| Cash on hand | | 16.369 |
| Profit and loss (surplus) | | 46,546 |

## PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 31, CITY TRUST BUILDING, 927 Chestnut St.,
PHILADELPHIA, Pa., Feb 23, 1893.

**J. W. Parker & Co.,** Philadelphia representatives of the Ball engine Co., Erie, Pa., have lately installed a 100-h. p. Ball engine for the Bloomsburg Electric Light Company, Bloomsburg, Pa.

**Vallee Bros.,** dealers in electric light supplies, report trade better than at any time during their experience in the electrical business. They are now negotiating for more room, when they expect to still further increase their business. In consequence of the above they regret their inability to be represented at the electric light convention.

**The Cutter Electrical and Manufacturing Company,** Philadelphia, has just issued a very neat catalogue and price list descriptive of its various C. S. specialties. Mr. H. B. Cutter, president and general manager of this firm, has engaged a suite of rooms at St. Louis during the convention, where he will have on exhibition his well known specialties, C. S. flush double push switch, single pole, double pole C. S. flush key switch, C. S. flush automatic switch, etc., and where he will be pleased to meet his numerous friends.

**The Arnold Electric Company,** of Chester, Pa., electrical contractors and manufacturers of dynamos and motors, has just completed the installation of an electric plant in the new House of Refuge at Linwood, Pa. This plant consists of four 600-light Arnold machines, and a switchboard which is said to be the largest solid piece board ever made. This plant was put in on a competitive basis as to efficiency with some of the largest electric light firms in this country for competitors. The dynamo test was 90 per cent. commercial efficiency. The Arnold Electric Company, though comparatively new in the field, has already attained a reputation for its high grade dynamos that any firm might be proud of.

**Mr. William McDevitt,** chief of the electrical department of the Philadelphia Fire Underwriters' Association, sailed for Europe on the North German Lloyd steamship Lahne on Feb. 21, 1893. Many claims have been made by authorities in foreign countries of superior methods in the distribution and use of the electric light, especially as to wiring and its application to houses, and for safety from fire. This subject Mr. McDevitt will particularly inquire into, and he will also examine the safeguards used for the protection of theatres. Mr. McDevitt will visit Berlin, London, Paris Vienna and Marseilles, and goes at the request of nearly all the electrical contractors, central stations and electrical engineers in the city of Philadelphia who are interested in this work, and who believe that our methods are not very far behind. The Philadelphia Fire Underwriters' Association has granted Mr. McDevitt a two months' leave of absence, and he carries with him letters from Hon. Edwin S. Stuart, Mayor of the city of Philadelphia, to the municipal authorities abroad, besides other letters which will give him the entrée to all places he may wish to visit.

## NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Feb. 23, 1893.

**Mr. J. P. Robinson,** of Providence, R. I., has severed his connection with the American Screw Company, of that place, in whose employ he has been for the past five years.

**The Robinson Radial Car Truck Company** has brought suit against the West End Street Railway Company of Boston, Mass., for infringement of certain letters patent owned by the former company covering the manufacture, sale and use of electric radial trucks. The West End Street Railway Company has been using over fifty of the standard Robinson electric radial six-wheeled trucks for several years and is still using them. These it purchased in regular course from the Robinson company, and they are, it is claimed, the best and most economical trucks on the West End roads. The West End company has also been using a large number of eight-wheeled cars The West End company determined to equip with radial trucks about one hundred additional car bodies originally built for the eight-wheeled equipment. Without license or authority from the Robinson company it has built and put in operation within the last three or four months, it is claimed, about one hundred Robinson electric radial six-wheel trucks, differing from the standard Robinson radial only in a few minor details. As late as Nov. 16 the West End company, being threatened with suit for infringement by the Robinson company, made application, it is stated, to that company for a license to cover said infringing trucks and made a proposition in settlement for the same, but the application for a license was refused and the proposition rejected by the Robinson company. The Robinson company claim that Patent No. 436,742, claims 1 and 2, and Patent No. 436,743, claims 1, 3 and 4, and various claims of Patent No. 436,439, all dated Sept. 16, 1890, have been infringed.

## WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Feb. 23, 1893.

**C. W. Crankshaw,** treasurer of the Sterling Boiler Company, Chicago, has just returned from a short business trip to New York Boston and other Eastern points.

**The Hammond Electric Street Railway,** Hammond, Ind., is approaching completion. The steam plant was furnished by the Chicago office of the Ball Engine Company, 506 The Rookery.

**George Cutter** has sold his shop to H. H. Cutler (of voltmeter fame), and E. W. Hammer, formerly of Ottumwa, Iowa. The new firm will go under the name of Cutler & Hammer, and will make a specialty of repairing apparatus and developing new ideas.

**The C. H. Stoelting Manufacturing Company** has just re-opened a factory at 128-130 South Clinton street, Chicago, and is again ready for active business This company had a loss by fire on Jan. 27, although the principal part of the machinery was saved in fairly good shape, and with a good line of insurance Mr. Stoelting has been able to increase his facilities to a considerable extent.

**The Rockford Electric Manufacturing Company** has been awarded the contract for putting in an electric light plant at Schott's saddlery works, Quincy, Ill. There will be 150 lights, and the contract price is about $800. The work will be completed in thirty days. There were 31 bidders and some lower than the Rockford, but none with better backing and recommendations, says the Quincy *Herald*.

**C. G. Muller,** general manager of the Copenhagen Automatic Fire Alarm Company, suffered the loss of 5,000 rheostats in various stages of manufacture, in the fire that destroyed the Stoelting Manufacturing Company's works, 62, 66 South Canal street, Chicago, on Jan. 27. The building had no fire alarm apparatus installed, and was nearly a total loss. Mr. Muller has renewed his contract with the Stoelting company and in a short time will have a large stock of rheostats ready for the market.

**The Electric Appliance Company** has taken the Western agency for the celebrated "O. K." weatherproof house, line and feeder wires and will carry a large and complete stock in Chicago. The quality of the "O. K." products is too well known to call for any extenhed comment. This company also reports that business is already beginning to open up on the Meston Alternating Current Fan motor and that it has already closed a number of agency arrangements and entered some very large orders for fan motors. The Meston motor is so well known that applications come in from every part of the country and the Electric Appliance Company plans to have a good live agency thoroughly established in every large town having an alternating plant before the fan season opens up.

**The Webster Chemical Company,** of St. Paul, after a series of experiments, has recently perfected and placed upon the market a chemical coloring compound for the coloring of incandescent lamps. It has always been a source of annoyance to the supply houses to carry in stock a complete supply of colored lamps, and since the demand for decorative purposes is constantly increasing the means for overcoming this difficulty is heartily welcomed by all. By the use of this process any desired shade of colored lamps can be made at short notice, and in addition an excellent "ground glass effect" is obtained. The process is very simple and practically instantaneous, the lamps being merely immersed in a bath of the solution, drying instantly upon exposure to the air and giving a brilliant and durable color.

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CLEVELAND, O., Feb. 23, 1893.

**A New York syndicate,** it is rumored, is endeavoring to buy up the two electric light plants and three street railways in Tiffin.

**No action** has as yet been taken by the other roads in the city regarding a reduction in fares corresponding to that made by the East Cleveland Company.

**The Findlay Electric Street Railway Company** proposes to extend its line at once to Fostoria, there to connect with the proposed Put-in-Bay line.

**The Norwalk Electric Light Company** has increased its capital stock from $25,000 to $50,000, and elected a new set of officers with the exception of the manager.

**State Railroad Commissioner Kirkby** has requested that all the laws governing steam railways be extended to the government of electric railways in this State, in so far as they are applicable.

**The Civil Engineers' Club** last Thursday night a very interesting paper was read by Mr. Ludwig Herman, on a weldless chain, a recent invention of his own. The club expects to hold its annual banquet soon, and has appointed a banquet committee.

**A petition** is being circulated among the motormen and conductors of the Woodland Avenue & West Side Railroad Company against the passage of the bill now before the Legislature compelling all cable and electric railway companies in this State to vestibule their cars. It is understood that, so far, but one man has been induced to sign.

**The annual meeting** of the Brooklyn & South Side Street Railway Companies was held at the National City Bank on Thursday last. The secretarys' report showed that the receipts for the past year have been a little over $499,000. The following gentlemen were elected directors for the ensuing year. Hon. Tom L. Johnson, A. L. Johnson, L. A. Russell, Dr. A. I. Dupont, H. J. Davies, John F. Whitlaw, and W. B. Hale.

**The equipment of motors** for the Woodland avenue and Lorain street road was completed on Monday last and the remaining horse cars taken off that line. Motor and horse cars still run alternately on the Detroit street line, but it is expected that by next Sunday the electrical equipment for that line also will be complete. The only horse cars then remaining on the system will be those on Fulton and Bridge streets and Franklin avenue. These also will eventually be displaced by motors.

**The City Cable Railway Company** has followed the example of the East Cleveland company in offering prizes for good service to its employés. Conductors, drivers, and gripmen in its employ who will have been in the service of the company a year or more on Nov. 1, 1893, will each receive $100. The plan of thus rewarding men for long and faithful service was adopted several months ago, but was not made public at the time. It was the outcome of a request for higher wages by the employés.

**A new scheme for rapid transit** in this city came to light on Monday last in the form of a proposed elevated electrical railway running from the Square to Euclid Heights in the East End. The plan is being pushed by O. D. Miller, and is said to backed by New York capitalists. The route proposed is from the Public Square via Rockwell street, past Wade Park and Lake View Cemetery to Euclid Heights, with a spur to Gordon's Park following the line of Doan Brook. It is expected that this route would reduce the time from Euclid Heights to the Square to 30 minutes.

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DETROIT, Feb. 23, 1823.

**J. E. Lockwood** will represent the Detroit Electrical Works at the National Electric Light Convention. St. Louis, but being overcrowded with orders will have no exhibit there.

**The Detroit Electrical Works,** after making the required severe tests with others, have secured the contract to furnish 60 car motors for the Citizens' Street Railway Company, Detroit, and other necessary equipments.

**The Electrical Equipment Company,** James J. McKenna, manager, has sold out to the Singer Electric Company, Detroit, Mich., 115 Griswold street, John R. Wood, manager, which will continue wiring and electric light repairing in conjunction with the Detroit Singer Fire Alarm Company.

**Wm. M. Porter,** Detroit, agent for the Ball & Wood Engine Company, Hodges Block, has just taken a contract for a 150-h. p. Ball & Wood engine for the new electric light plant, Wyandotte, Mich. The Western Electric Company, Chicago, Ill., will furnish the electrical apparatus for this plant.

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TACOMA, Wash., Feb. 17, 1893.

**Citizens of Eugene, Ore.,** have petitioned the County Court to grant a franchise for an electric road across the steel bridge at Springfield, with a view to insuring the construction of the proposed electric railway to connect the two towns.

**The electric roads** of Tacoma, Seattle and Portland, Ore. have been partly disabled several times this winter, owing to unanticipated heavy snowfalls. The climate in western Washington and Oregon is generally so mild that snow plows and sweepers have not hitherto been considered necessities of a well regulated street railway system.

**The Tacoma Light and Water Company** has been awarded the contract to supply 1,700 incandescent lights, to be located in the new City Hall, the Tacoma Theatre and the Gross Building. The proposition to install an independent plant to light the buildings was thus knocked in the head, but had the result of obtaining favorable rates on lights.

**The city of Portland, Ore.,** is considering the advisability of selling the East Side electric light plant, which it is said costs the municipality $4,000 per year more to run than would be required to pay for the same number of lights supplied by private enterprise. It is a comparatively small plant which was acquired by the city, upon consolidation with East Portland.

**The Everett Railway and Electric Company,** under the superintendence of Leo Daft, is making rapid progress with its new lines and cars will be in operation within ninety days, it is claimed. There will be three Ball engines aggregating 500 h. p. in the station. Westinghouse railway generators and incandescent lighting machines will be used. The Standard Electric Company, of Chicago, will supply the arc machines. The power house now in course of construction will be of brick, 57 × 97 feet and one story high. The rails have been shipped from Philadelphia. Cars will run from the power house on Federal street along Hewitt and Pacific avenues to the steel barge works and the smelter. There will be a long line from the smelter to Lowell, a distance of four miles. The cars have been built by the American Car Company of St. Louis.

## CANADIAN NOTES.

OTTAWA, Feb. 23, 1893.

**The City Council** of London, Ont., for 1893 has resolved to take up the electric street railway question from the beginning. It has filed the offers of the past, and will call for more.

**Mr. John Foster,** of Toronto, has commenced an action against the street railway company for $5,000 damages for injuries suffered by him on Nov. 19 last, caused by the alleged negligence of the defendants.

**Truro, N. S.**—A circular has been issued by the Chambers Electric Light Company asking for signatures from patrons of the company as to whether they are satisfied with the present electric light all night service at prices charged, or to know if they would be willing to accept a service closing at midnight at two thirds the present price.

**The citizens of Aylmer** are getting tired of the meagre arrangements between that place and Ottawa. Mayor Ritchie has a good scheme, but he doubts his ability to carry it out. The idea is an electric road, and the mayor is prepared to find a right of way from Aylmer to the Deschenes Mills, where there is plenty of power. The idea would then be to run a toll bridge across to Britannia and so into the city.

**Thomas A. Edison** has written to a Toronto journal which asked his opinion as to the possibility of transmitting to Toronto for manufacturing purposes electricity generated at Niagara Falls. Mr. Edison admits the practicability of the scheme, but suggests that the cable of transmission would be liable to disturbance by ship anchors; and further, that it is doubtful if such a scheme would not be more costly in any case than the generating of electricity in Toronto itself, despite the high price of coal.

**Winnipeg.**—According to rumors on the street, Mr. Austin has no intention of relinquishing his service of street railway. It is said that the manager of the Winnipeg Street Railway Company has been in New York investigating a new system of motive power combining the elements of the cable and electric service, making the overhead wire unnecessary. If the new method should be adopted it will mean considerable expense to Mr. Austin's company, as new cars will have to be secured and much work done before the horse cars can be abandoned.

**St. Catherines, Ont.**—Application has been made to the Township Council for permission to construct and operate an electric railway along certain roads and highways in the township of Grantham. The by-law authorizes the parties named to construct an electric railway along the Lake road from Port Dalhousie to its intersection with Lake street, and southerly along Lake street to the city of St. Catherines; also along the traveled road between Port Dalhousie and St. Catherines (Ontario street) from the village of Port Dalhousie to the north side of the New Welland Canal.

**The Auer Light Company,** which was started in Montreal a couple of months ago, is about to become extinct. Through some secret fluid, which was to be obtained from Dr. Auer, a Viennese scientist, a very brilliant light was to be obtained, and a company was started with a capital of half a million dollars. A large number of prominent citizens were members of the company. It has turned out, however, that there was no contract with Dr. Auer for 15 years for a supply of the fluid, and the Montreal men who promoted the company have come to the conclusion that they cannot keep their agreement with the shareholders. Offices had been secured by the company and some of the lights put into business houses.

**Brantford, Ont.**—The question of lighting the city has come up in the meetings of the City Council, owing to the expiration of the contract with the Electric Light Company. A new contract was made for one year with the same company. Since this contract was given a new company has been formed with increased capital, which has taken over and is enlarging and permanently refitting the old plant, so that the citizens may expect to secure at a reasonable price much more efficient lighting than they have had in the past. A new arrangement very advantageous to the city has been made with the Bell Telephone Company, by which the city secures the use of the company's poles for their lines, and a payment of $450 per year. The hopes that were expressed last year in regard to the electric street railway are about to be realized in the completion by the Canadian General Electric Company of a plant said to be second to none.

## ENGLISH NOTES.

*(From Our Own Correspondent.)*

LONDON, Feb. 8, 1893.

**Liverpool Overhead Railway.**—This line has been successfully opened by the Marquis of Salisbury.

**Mun Lighting.**—The municipality of Bolton (Lanes) has decided to spend £40,000 on an electric lighting sheme.

**Electric Lighting in Parliament.**—The glow lamp was recently raised to the peerage, the House of Lords being lit for the first time by Edison-Swan lamps.

**Post Office Telephone Trunk Wires.**—A conference of post office officials has been held under the presidency of Mr. Preece, in view of the proposed immediate construction by the post office of a network of heavy interurban telephone trunk wires.

**Death of Mr. J. E. H. Gordon.**—A few days since Mr. J. E. H. Gordon, well known in this country as the author of a much read treatise on "Electricity and Magnetism," and the designer and contractor for several large lighting stations, was thrown from his horse and killed.

**Municipal Electric Lighting.**—Permission for an electric lighting loan of £15,000 has been granted to the municipality of Derry. On the other hand the Croydon Town Council has decided to postpone the spending of £22,000 on electric lighting, notwithstanding the alluring statement of Mr. Preece that electricity at 7d. per kilowatt-hour is equivalent to gas at 3s. 6d. per thousand.

**The Johnston Conduit.**—The International Electric Subway Company, which owns the Johnston system of conduits in this country, is putting down a short length of Johnston conduits in John Carpenter street, close to Blackfriars Bridge, for use by the City of London Electric Lighting Company. This is the first chance the company has had of showing the advantages of its system.

**Electric Motors for Men of War.**—One of the effects of the recent severe frosts in this country has been the complete disablement of the hydraulic gear of H. M. S. Benbow, and as a paragraph concerning it is going the round of the press public opinion will, perhaps, be awakened to the desirability of substituting electric motors for hydraulic gear, at any rate tentatively, upon some of our war ships.

**Trial of Patent Cases.**—For some little time past technical journals in this country have advocated the adoption of a system for patent cases similar to that in vogue here for nautical cases, in which the judge's law is assisted by the technical advice of experts sitting beside him as "assessors." The heading of the patent action Paine *v.* Thompson, which has come before Mr. Justice Wills, is interesting in so much as Prof. George Forbes is assisting the judge as "technical assessor."

**St. James and Pall Mall Electric Light Company.**—This prosperous electricity supply company has paid a dividend of 7¼ per cent., in addition to setting aside substantial sums for depreciation and to a capital redemption fund. This good record has been achieved in spite of the fact that a large capital expenditure was incurred in 1892 on a new station, which has not as yet earned a penny. The lampage of the company has increased during 1892 by over 24 per cent., but not so the gross revenue, which only expanded by a little over 10 per cent. Notwithstanding the increase in the number of units generated, the cost of fuel remained stationary, and several items, such as oil, waste, water, etc., actually decreased.

**City & South London Railway.**—The report of this company for the last six months of 1893 is fairly satisfactory from the shareholders' point of view, and very satisfactory from the electrical engineering point of view. Interest is paid upon debentures and preference shares, and the ordinary shareholders receive a return at the rate of ⅝ per cent. per annum. Comparing the receipts of the last six months of 1892 with those of the corresponding period of 1891, it is seen that they amount respectively to £22,000 and £19,800, the corresponding working costs being £15,390 and £15,516; corresponding number of passengers carried, 3,217,000 and 2,750,000; and corresponding train mileage, 214,417 and 188,666. Since the opening of the line, about two years ago, more than 11⅛ million passengers have been carried.

**Measurement of Telephonic Currents.**—Dr. Fleming is now delivering a course of four Cantor lectures on "The Practical Measurement of Alternating Electric Currents" before the Society of Arts. At the conclusion of the first lecture he showed a delicate little instrument devised by him, the principle of which consists in placing a small mass of iron eccentrically within an alternating magnetic field. The instrument is intended to afford some idea of the strength of telephonic currents. He showed in a very striking manner that the secret of good telephoning consists in possessing a voice corresponding more or less with the fundamental note of the diaphragm one speaks to. Hence the well-known superiority of high pitched over more deeply toned voices. On speaking loudly but not shrilly to the telephone, the spot of light on the screen scarcely moved at all. Upon pitching the voice in a higher key, however, the spot of light was violently thrown off the scale.

**Municipal Electric Traction.**—There seems every likelihood of a good opening for electric traction in Belfast. The option of purchase of the whole tramway system of that industrial city matures in August next, and the new agreement which it is proposed to enter into is exciting considerable opposition. In return for an annual rental of £4,000 for the first seven years and of £5,000 for the second seven years, the municipality is apparently ready to sign away its right of purchase for 14 years without any guaranty either of cheap fares, good service or modern improvements. Belfast is evidently a good field for the tramway. Within the last five years the number of passengers carried has increased considerably more than 100 per cent., the total for the 19¼ miles now in operation standing at over 16,000,000. The ratepayers have subscribed a considerable sum of money to oppose the agreement.

**Electric Meters in Trouble.**—The local electric lighting company at Bath recently changed over from the system of supplying current to 10 c. p. lamps throughout the year for six shillings to a meter supply at 6d. per kilowatt-hour. The receipt of the bills for the Christmas quarter by the consumers led to as near an approach to an uproar as the inhabitants of such a staid city as Bath can be expected to indulge in. Some consumers threaten to bring legal proceedings, others to cut off the light, and others again to call a public meeting. Had the company possessed a diplomat on its staff, it would certainly have postponed this change until the summer quarter. As it is, a large number of consumers find that a winter quarter's bill by meter is a considerable portion of the total annual sum under contract, and refuse to be mollified by the assertion of the company that this state of things will be altered as the days grow longer. I may add that the meters used were made by the Westinghouse company and are therefore presumably Shallenberger meters, the only type, by the way, which has as yet been certificated by the Board of Trade.

**National Telephone Company v. Graff-Baker.**—Somewhat to the surprise of the electric tractionists, Mr. Justice Kekewich's decision in the above action was given in favor of Mr. Graff-Baker. The judge in the course of his lengthy judgment reviewed the whole of the evidence, and decided that the tram cars undoubtedly did disturb the telephones, and to such a degree that it was a case for an injunction and not merely one for damages. He also held that at common law the telephone company had a right to protection. He wound up, however, by saying that since the trams were worked under an act of Parliament, and in accordance with a clause contemplating the use of electricity, the telephone company had no legal cause for complaint so long as the cars were worked lawfully. So far, so good, but the present action will undoubtedly be carried to the Court of Appeal, and thence to the House of Lords, by which time the position of the two parties to the action may very possibly be reversed. It must also be remembered that the act under which the Leeds tram cars are worked is by no means a general one, since owing to the apathy of the traction and lighting interests the telephone people have been allowed to get clauses inserted in all recent acts which practically give them complete protection against all manner of electric disturbances. The present decision therefore will only hold good for such acts as do not contain this clause, and in future it behooves the threatened interests to stop the evil at its root, namely in the Legislature.

# News of the Week.

## THE ELECTRIC LIGHT.

**Arcade, N. Y.,** is to be lighted by electricity.

**Davis City, W. Va.,** is to have electric lights.

**Algona, Ia.,** is discussing the question of electric lights.

**Charlevoix, Mich.,** is going to erect an electric light plant.

**Devil's Lake, N. D.,** is to have electric lights and an electric railway.

**Iowa City, Ia.,** is to have an electric street railway and incandescent lights.

**Mason, O., citizens** have petitioned the Common Council for an electric light plant.

**Maquoketa, Ia.,** is to have electric lights and contracts have been let for seventeen arc lights for the streets.

**Caldwell, Idaho,** the county seat of Canyon county, is making extensive preparations for putting in an electric light system.

**Wm. Speirs,** manager of the Washington (N. J.) Silk Mills, has made application to the Common Council for a franchise to erect electric light poles in the borough.

**Addison, N. Y.,** has awarded the contract for lighting the streets by electricity to F. H. Wheaton, of that place. The contract calls for 25 arc lights of 2,000 c. p. and the plant is to be in operation before Aug. 1, 1893.

**The Des Moines Water Power Company** and the Edison Light Company of Des Moines, Ia., have been consolidated, both plants being purchased by a new company, the Des Moines Electric Light Company, with a paid up capital of $800,000.

**The Cincinnati Gas Light and Coke Company,** Gen. Andrew Hickenlooper, president, it is positively asserted has gained control of the Edison Electric Light Company, the strongest opponent of the gas company, and the other electric light companies controlled by it. The Edison company's plant was owned chiefly by Boston capitalists. The deal is of a similar nature to that consummated when General Hickenlooper purchased the Thomson-Houston company, the first Cincinnati Electric Light and Power Company and the Brush company, which were practically owned by the same persons who owned the present Edison company.

## THE ELECTRIC RAILWAY.

**The Carrolton (Mo.) Street Railway,** of which Mr. Alfred Hossick was president, has sold its franchise to F. V. Crouch & Co., who propose to install a dummy equipment.

**A new electric railway** from Bellaire to Martin's Ferry, O., and a branch from Bridgeport to the Wheeling Creek coal mines, is proposed. J. K. Jolly and A. R. Lyda, of Pittsburgh, are interested. They have the right of way through Bridgeport, have bought the old mule line in Bellaire, and are seeking from the Martin's Ferry council the right of way through that place.

**Columbia & Donegal Get the Rights.**—The Marietta & Maytown Electric Railway Company refused to accept the provisions of the ordinance recently adopted by the Marietta Council. The Council at its meeting on Tuesday evening adopted the ordinance presented by the Columbia & Donegal Railway Company. The latter agreed to give bond and put a horse car line in operation until the electric line could be erected. The Council did not ask this and gave the company until July 1, 1894, to start and until January, 1895, to complete the line.

## Industrial and Trade Notes.

**The Canton (O.) Steam Pump Company** has removed to Dixon, Ill., where it is known as the Miller Steam Pump Company.

**Pure Granulated Sal Ammoniac.**—Innis & Co., 120 William street, New York, are offering pure sal ammoniac, guaranteed over 99 per cent. pure. This company has a large stock on hand and is prepared to make prices on the same that all interested would do well to investigate.

**The W. Warren Thread Works,** of Westfield, Mass., have perfected a material to put on yarn and threads to make them fireproof. They are also putting threads and yarns up on paper tubes arranged so as to run direct on braiding machines in place of braider bobbins now employed.

**The Phœnix Iron Works Company,** of Meadville, Pa., has issued a very artistic catalogue, giving a very full description of the Dick & Church engine, as well as of the boilers manufactured by this company. The illustrations are especially complete and interesting, showing in detail every part of this well known engine.

**The Avery Stamping Company,** of Cleveland, O., has issued a little pamphlet descriptive of some of the many articles which it manufactures. In addition to all classes of heavy and light blanking, pressing and stamping of sheet metals, this company also builds presses, dies and special tools for this class of work.

**Regulation of Speed and Water Power** is the title of a little folder by Mark A. Replogle, Cedar Falls, Ia. The problem of the regulation of speed where the load is continually changing is always an important question, and is peculiarly difficult in the case of water power. The method which Mr. Replogle has used with his electric regulators has proved very successful.

**The Midvale Steel Company,** of Nicetown, Philadelphia, is much gratified at the record of engine No. 35 on the Cumberland Valley Railroad equipped with Midvale tires. From 1882 to April, 1888, this engine's mileage record was 328,969 miles; the tires were then turned and between that date and Dec. 31, 1892, the engine ran 173,591 miles, making a total of 502,560 miles—a remarkable record.

**"Fuse Wire and Its Use"** is the title of an interesting and instructive little pamphlet just issued by the Shawmut Fuse Wire Company, 161 High street, Boston, Mass. In a simple and attractive way it proceeds to tell what fuse wire is, how it should be used, the time required to fuse, the relation between carrying capacity and fusing point, etc., all of which is also graphically shown in some excellent diagrams.

**The Newell Belting Company,** of Hartford, Conn., has recently furnished the Elmira Illuminating Company, of Elmira, N. Y., a complete equipment of belts, consisting of one 50-inch and two 39-inch double belts; to the Philadelphia & Reading Railroad station at Philadelphia, 10 dynamo belts. The Tiffin, O., Edison Electric Illuminating Company, before it was destroyed by fire, used several Jewell belts, and since its reconstruction has been completely equipped with these belts.

**The Electrical Engineering and Supply Company,** of St. Paul, Minn., deserves credit for the very complete catalogue which it has recently issued. National incandescent dynamos and transformers, Standard arc light apparatus, high grade Packard lamps, paranite wires and cables, Grimshaw white core wires, "O. K." weatherproof line wire and Syracuse sockets, cut-outs and switches are but a few of the specialties which this company handles. Some interesting information in the way of tables and constants is also embodied in the catalogue.

**The Jerome Kidder Manufacturing Company** is receiving some flattering testimonials, among which are the following: The Texas *Courier Record of Medicine* says: "We have used electro-medical apparatus of many different makers and can truthfully say that those made by Jerome Kidder Manufacturing Company, 820 Broadway, New York, have proved to be by far the most valuable and satisfactory in every respect." E. C. Pence, M. D., writes from St. Louis, Mo., the following: "We have been practicing with your electrical machines over 25 years, and when we want anything reliable we will always send to you."

**Electrical Repairing and Testing.**—An important branch of the electrical business to-day is the repairing of electrical apparatus and machinery, and the testing of apparatus before it is put into actual service. As a consequence several firms are now engaged in this line of business, prominent among which is the firm of W. S. Chesley & Co., 24 Morris street, Jersey City, N. J. This company has recently fitted up a general repair shop with all the latest improved machinery for the repairing and testing of electrical apparatus. The shop is located only a few moments' ride from New York, has telephone connection and possesses unusual facilities for the prompt repairing of anything in the line of electrical machinery. Only first class labor is employed, and a specialty is made of railroad and isolated plant work. Parties purchasing apparatus and desiring to see the same tested before put into actual service will find that W. S. Chesley & Co. are prepared to set up any make of apparatus, test the same to the entire satisfaction of the purchaser, and guarantee the work required after such test. Those who have specialties either for sale or manufacture would do well to confer with this company.

**The following comparative tests** were made at the Worcester Polytechnic Institute, Department of Physics and Electrical Engineering, Worcester, Mass., on Feb. 15, 1893, using samples of Salamander lamp cord, manufactured by the Washburn & Moen Manufacturing Company, and samples of other makes of fireproof lamp cord. The tests were conducted in the following manner: Six inches of Salamander double cord was joined in series with the same length of two other makes. An electric current of 36 ampères was then turned on and left for some minutes. The Salamander cord was not affected, while the other makes were first charred, then took fire and then wholly burned off, leaving the bare wire a dull red. The current was then increased to 41 ampères, which heated the bare wire of the other makes to a very bright red. This test lasted for about seven minutes. On cutting open the insulation of the Salamander cord after test the white cotton was found uninjured by the heat, the fireproof covering continuous and the gutta percha apparently unchanged. At any time during the test the Salamander could be held in the hand without inconvenience from the heat, while the other makes were entirely demolished.


## Business Notices.

**Transformers** rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

**Oil Filters** for sale cheap. Send for prices to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

**Battery Cut-out, Cheap.**—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

**Johnston's Street Railway and Electrical Directory.**—What others say of it:

"We are much pleased with the work and consider it a valuable book for any one interested in the electrical field."—Dodge Manufacturing Company, Chicago.

"Seems to be a very complete directory, and think it will prove a very useful volume."—Webster, Camp & Lane Machine Company, Akron, O.

"We are pleased with it."—The Hartford Light and Power Company, Hartford, Conn.

"I must say it is an entire success from beginning to end."—W. D. Wilson, Tarpon Springs, Fla.

"It is all right."—Chas. G. Armstrong, Chicago.

"We consider it a valuable aid in our business."—The Russell & Officer Electrical Construction Company, Denver.

"It seems to cover ground very fully."—The Mountain Electric Company, Denver, Col.

"Very much pleased with new directory. Its one in the repair or electrical business can do without it."—Pioneer Armature Works, Chicago.

"It is as handy as a city directory."—California Electrical Works, San Francisco.

"I think the work very comprehensive."—Arthur R. Roe, Duluth, Minn.

"Find it very interesting. Think such a publication of great use to the electrical fraternity."—J. G. Kaelber, Rochester, N. Y.

"The book seems to be very complete, accurate and tastily gotten up."—The Fitch Battery and Electric Company, Oneida, N. Y.

"A valuable help. Have looked it over with pleasure."—Holtzer-Cabot Electric Company, Boston, Mass

"Seems quite complete and certainly presents a fine appearance."—The Buckeye Electric Company, Cleveland, O.

"We are very much pleased with it. It is certainly a great improvement on anything of the kind ever gotten up."—Houliston & Co., Cincinnati, O.

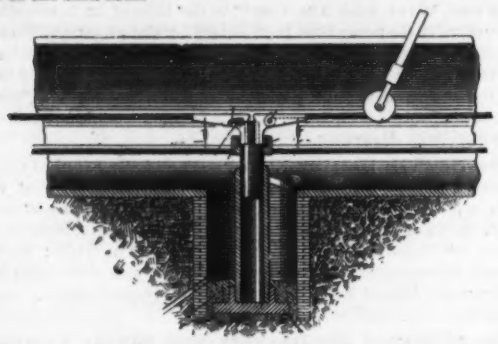
# OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

## UNITED STATES PATENTS ISSUED FEB. 21, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

**491,982. Electric Motor and Controlling Apparatus for Cars;** John V. Capek, New York, N. Y. Application filed Nov. 14, 1891. The combination of a field-magnet, an armature in sections, one or more commutators for the armature, and circuit connections such that a section of the armature will be rotated by the effect of the field magnet, and another section of the armature will be rotated by attraction at the first armature section.

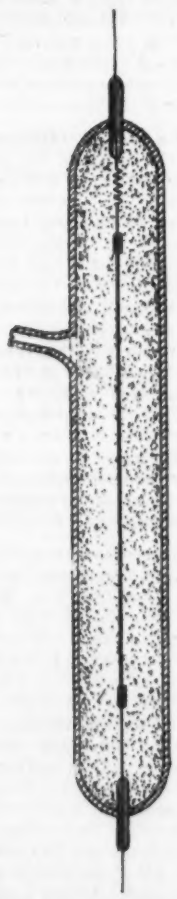
**491,988. Electric Railway Trolley;** Alfred Dickinson, Darlaston, Eng. Application filed Feb. 9, 1892. A standard consisting of a fixed and longitudinally slotted lower part and an upper part moving up and down telescopically therein, the said upper part being provided with a stud which slides in the slot of the said lower part, and may be turned into lateral branches thereof, in combination with an arm attached at or near one end to the upper part of the said standard, springs connecting the said standard to the said arm and a trolley pivoted on the other end of the said arm.



No. 492,106.—Conduit Railway.

**491,990. Multipolar Dynamo Electric Machine Armature;** George Edensor Dorman, Chicago, Ill. Application filed Jan. 4, 1892. The combination of an armature core having circular rests at its ends with a series of coils substantially elliptical and placed upon the core parallel to the axis and having their ends bent over into such rests to be thus secured.

**491,992. Cut-Out for Incandescent Electric Lamps;** Thomas A. Edison, Llewellyn Park, N. J. Application filed Nov. 12, 1891. The combination with an incandescent electric lamp of a passage open to the air at one point and closed by the seal through which the leading-in wires enter the vacuum chamber, and a cut-out device for the lamp having a movable member situated in said passage.



No. 492,150.—Process of Coating Conductors for Incandescent Lamps.

**492,003. Manufacture of Chlorates of the Alkaline Metals and Metals of the Alkaline Earths;** Henry Gall, of Hermes, and Amaury de Villardy de Montlaur, Paris, France. Application filed July 21, 1892. In this invention is employed an electrolyte containing in solution a chloride and a current passing through it between electrode compartments separated by a porous diaphragm, and depolarizing the electrode of the negative compartment by continuously conveying the contents of the negative compartment into the positive compartment, whereby the chlorine liberated in the latter is availed of in the nascent state.

**492,008. Pole Standard Arc Lamps;** Frederick D'A. Gould, Schenectady, N. Y. Application filed April 15, 1892. A standard for arc lamps, having a base adapted to be secured to a support such as a pole, side rods, a cross-piece at the upper ends of said rods and bent or deflected to allow the lamp to stand between the side rods but at the same time to extend above them, and means also at the upper ends of the side rods adapted to engage or hold supporting devices projecting from an arc lamp.

**492,011. Electrical Indicator;** Henry J. Haight, New York, N. Y. Application filed June 1, 1892. The combination of an electric transmitting instrument, an electric receiving instrument controlled in its movements by said transmitter and an automatic cut-out controlled in its movements by said receiver, said transmitter having two sets of alternating contacts, all of which are in electrical communication with the electro-receptive provision of said receiver, said automatic cut-out having two sets of alternating electro-conductive sections, each of which is in an independent circuit, including one of the two sets of contacts of said transmitter, said automatic cut-out including a brush or equivalent contacting device co-operating with said electro-conductive sections one by one and in circuit with the electro-receptive provision of said receiver, and said transmitter including two independent and insulated electrodes, each co-operating respectively with the contacts of one of said sets of contacts one by one, each of said electrodes being in circuit constantly with one of said sets of electro-conductive sections of the automatic cut-out.

**492,019. Magneto Telephone Switch;** William Humans, Cambridge, Mass. Application filed July 23, 1885. In combination a magneto generator, a magneto telephone, a signaling apparatus, a switch automatically controlled by the generator and consisting of one moving electrode between two fixed electrodes, a second switch automatically controlling the magneto telephone, and consisting of one moving electrode between two fixed electrodes, a conductor connecting the moving electrode of the generator switch with that fixed electrode of the telephone switch which is normally in contact with the moving electrode of that switch, a conductor connecting that fixed electrode of the generator switch which is normally in contact with the moving electrode of that switch, with one terminal of the signaling apparatus, a conductor connecting the other fixed electrode of the generator switch with one terminal of the generator, a conductor connecting the other terminal of the generator with that terminal of the signaling apparatus connected with the generator switch, a conductor connecting that fixed electrode of the telephone switch normally out of contact with its moving electrode, with the telephone and through it to line, a conductor connecting the moving electrode of the telephone switch to line, and a conductor connecting the other terminal of the signaling apparatus to line.

**492,036. Automatic Circuit-Breaker for Motors;** Robert T. Lozier, New York, N. Y. Application filed April 4, 1892. The combination of a shunt motor, a circuit-breaker in the main motor circuit outside of the motor terminals, means, such, for example, as a spring, tending to move the same to its open position, and an armature, in operative relation to the field-magnet of the motor, connected to said circuit-breaker so as to close the circuit when the armature is attracted.

**492,106. Conduit Railway;** Frank B. Rae, Detroit, Mich. Application filed April 11, 1891. In an underground conduit system for electric railways, the combination with the wellholes of supports embedded in insulating material therein, and extending into the conduit, a trolley wire in sections, the ends of the two adjacent sections being attached to the supports in the wellholes. (See illustration.)

**492,110. Automatic Individual Telephone-Call Apparatus;** Joseph Sack, Berlin, Germany. Application filed Sept. 18, 1891. The combination of lever with pins, discs, having nose, and lever with which the lever is adapted to make contact.

**492,124. Duplex Electric Arc Lamp;** Barton B. Ward, New York, N. Y. Application filed May 17, 1892. Amultiple carbon lamp having two or more independent regulating mechanisms and corresponding simultaneously burning pairs of carbons, two or more corresponding feed controlling magnet systems in continuous operative connection with the electric circuit, and a frame common to said pairs of carbons and magnet systems.

**492,150. Process of Coating Conductors for Incandescent Lamps;** Thomas A. Edison, Menlo Park, N. J. Application filed Oct. 26, 1892. The process of coating a flexible carbon filament, designed for the incandescent conductor of an electric lamp, with insulating material, consisting in embedding such conductor in an insulating oxide or compound in a suitable receptacle, exhausting air therefrom, and finally passing a current through said filament, sufficient to fuse a coating of such oxide onto the filament, substantially as set forth. (See illustration.)

**492,160. Electric Elevator;** Frank E. Herdman, Indianapolis, Ind. Application filed March 8, 1892. In combination with an electric motor, an electric motor controlling switch, a brake wheel, a brake wheel upon said wheel, a cylinder, a piston in said cylinder, a supply pipe to said cylinder, a valve on said pipe and intermediate connection between said valve and the switch and intermediate connection between said piston and the brake.

**492,176. Commutator for Dynamos or Motors;** Joseph A. Williams, Cleveland, O. Application filed May 2, 1892. In a commutator for dynamos and motors, the divided, chambered and slotted body having annular flanges, segmental bars having beads or ribs fitted to rest in the grooves in the surface of the body between the slots, and having beveled ends held in bevel grooves in the body flanges; perforated disc having neck; sleeve bolt and nut binding the body, segmental bars and disc together, and the annular chamber, all constructed to operate as and for the purpose set forth.

**492,200. Electric Arc Lamp;** Henry Harper, London, England. Application filed July 10, 1891. In an electric arc lamp, the combination with a tubular magnetic dashpot, an upper carbon, and a holder for the upper carbon in the end of the tubular dashpot, of a solenoid surrounding the dashpot, a stationary piston arranged within the dashpot, and a cushion charge submerging the piston.

**492,201. Electric Arc Lamp;** Henry Harper, London, England. Application filed July 10, 1891. In an electric arc lamp, the combination with the solenoid of the core thereof, bearing the upper carbon, said core composed of insulated iron wires massed together and inclosed in a non-magnetic tube, and the holder of the upper carbon connected to said core.

**492,215. Hanger for Electric Incandescent Lamps;** Samuel O. Larkins, Blair, Neb. Application filed Feb. 17, 1892. The herein described hanger, comprising the base, two depending arms, a spring actuated reel journaled in the lower ends of said arms and having a pawl and ratchet connection therewith, rings on the opposite ends of the reel and connections with the lamp suspending cord, two springs between the lower ends of which the reel revolves with its rings in contact therewith, a notched ring on one end of the reel, and a spring friction pawl engaging the said ring to hold the reel frictionally, but release it when the lamp suspension cord is operated.

**492,219. Lightning Conductor and Arrester;** Adelvin B. Lyman, Cleveland, O. Application filed Oct. 28, 1892. In a lightning conductor and arrester the vibrating arms mounted on suitable posts and having electrically conducting terminals, normally separated by adjusting screws situated back of the pivotal connections of said arms, in combination with the lever having non-combustible, insulating material in its free terminal, an armature and the insulating levers connecting said lever with the arms and an electromagnet and spring for actuating the lever whereby the terminals of said arms are widely separated or drawn near together.

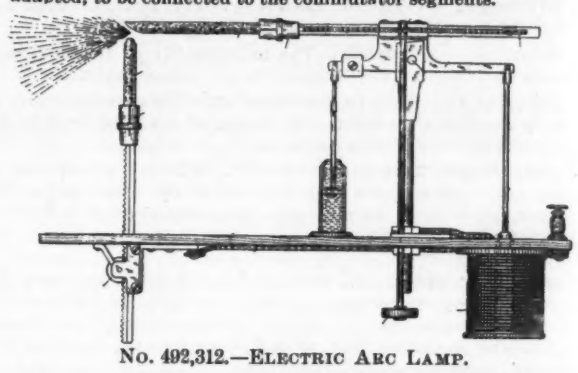
**492,236. Low Water Indicator for Boilers;** William Henry Rodgers, Bay Side, N. Y. Application filed June 24, 1892. In a device of the character described, the combination, with a bent and flattened tube, of a tube connected and having communication therewith, an expansible liquid contained in the bent tube and in its connected tube, an outer or casing tube surrounding the liquid-holding tube, and having a connection affording free communication with the water space of the boiler and adapted to admit steam when the water falls to or below the level of said connection, an alarm device and an electrical connection between the alarm device and the flattened tube.

**492,244. Method of Constructing Armature-Cores for Electric Motors or Dynamos;** Albert W. Smith, San Francisco, Cal. The process of making magnetic cores, which consists in building up the same of plates or parts, and surface welding the same together at the points or paths of least magnetic flow or cutting by means of the electric arc. (See illustration.)

**492,245. Magnetic Tool;** Jacob F. Standiford, Muscogee, Ind. Ter. Application filed July 14, 1892. A combination with magnets and a casing, a vibrating armature extending across the upper ends of the magnets and having a vertical transverse aperture through it in line with the hollow core of one magnet, a spring throwing the armature away from the magnets, a tool holder extending loosely through the aperture in the armature and hollow core and provided with a transverse pin or projection crossing the upper end of the armature, a spring against the action of which the armature raises the tool holder, the battery circuit and means for closing the circuit when the armature lever rises.

**492,247. Electrical Footwarmer;** William Eugene Ulmer, Hoquiam, Wash. Application filed April 27, 1892. An electric footwarmer, consisting of a box provided with a cover having openings therein, slotted standards projecting from the bottom of the box, electric lamps held in the said slotted standards, reflectors under the lamps, cut-outs held in the box and connected with the lamps, and electric wires leading from the box and with which the cut-outs are connected.

**492,251. Dynamo Electric Machine;** Wallace E. Freeman, Long Island City, N. Y. Application filed July 8, 1892. An armature for dynamo electric machines, consisting of a core wound longitudinally with wire in sections of three layers each, the inner layers being wound in one direction and the outer layers in an opposite direction, the intermediate layers and the inner and outer layers having their wires connected as described, and the intermediate and outer layers having extended terminals adapted, to be connected to the commutator segments.

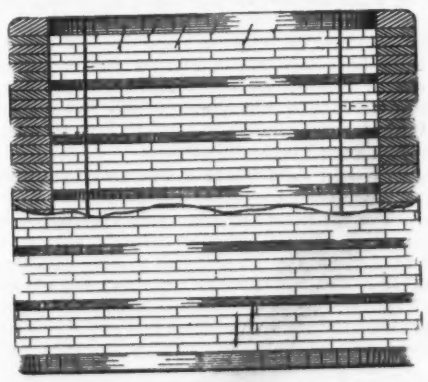


No. 492,312.—Electric Arc Lamp.

**492,265. Conduit Electric Railway;** Fred W. Brann, Oakland, Cal. Application filed May 16, 1892. In an underground electric railway, the combination of the underground conduit having the slot on top through which communication is made between the car and the conductor within the conduit, an A-shaped roof made of non-conducting material and secured to the conduit frames at one side and out of line with the slot, and a second interior non-conducting strip secured thereto with intervening non-conducting plates, hangers projecting from the interior strip having a conducting wire attached thereto beneath the overhanging edges of the projecting channel.

**492,291. Commutating Apparatus for Dynamo-Electric Machines;** Edward J. Houghton and William White, London, Eng. Application filed March 26, 1892. A commutator brush, consisting of layers of wire gauze, a sliding box in which said layers of wire gauze are arranged, a spring acting to advance the box, a pressure plate bearing against the said layers, and a screw acting on the pressure plate.

**492,301. Coupling for Trolley Wires;** William Henry Keckeley, Covington, Ky. Application filed Dec. 10, 1892. In a wire or rod coupling or connector, a double pointed or tapered box or frame having a triangular chamber or receptacle at either side, a central partition or abutment wall, an inlet opening or orifice at either end, a side opening or openings for both said chambers, a lid or plate covering said side openings, and wedges or claws suitably mounted within said chambers.



No. 492,244.—Method of Constructing Armature Cores for Electric Motors or Dynamos.

**492,309. Electric Bell Alarm;** Gustaf Libert Reenstierna, Boston, Mass. Application filed Oct. 12, 1892. The combination in an electric bell alarm, of electromagnets arranged substantially at right angles to each other, an angular armature lever pivoted between the electromagnets and provided with angularly arranged armatures extending in different directions and lying opposite cores of the magnets, a hammer or striker connected with the armature lever below its pivot, spring electrodes located below the armature lever and having free extremities, an electrode extending between the free extremities of the spring electrodes, and suitable electrical connections.

**492,312. Electric Arc Lamp;** John Thompson, New York, N. Y. Application filed May 17, 1892. In an electric lamp, a carbon holder and means for moving it longitudinally, combined with another carbon holder and its supporting rod or rack, said carbon holders extending at an angle to each other; a lever carrying said rod or rack and adapted to move the latter laterally; means for moving the carbon holder longitudinally, and a regulator connected with said lever for moving the latter to regulate the arc, substantially as specified. (See illustration.)

**492,330. Electric Burglar Alarm;** Julius Kamsler, New York, N. Y. Application filed Dec. 15, 1892. A burglar alarm for windows and doors, consisting of a flat base plate provided with opposite contacts, a swinging lever pivoted at one end, movable in a plane parallel with the base plate and having its opposite end portion located between and adapted to make connection with the contacts on the base plate, a spring acting on the lever to move it in one direction, and a flexible thread connected with the lever and adapted to be engaged with a window or door for sustaining the lever free from connection with the contacts on the base plate until said thread is tightened, or loosened or ruptured.

**492,355. Magnetic Core for Armatures;** Thomas H. Hicks, Detroit, Mich. Application filed Oct. 6, 1892. The combination of an armature shaft of an armature core constructed of cast metal, and provided with outstanding collars at its ends, said core wound with magnetic wire, said collars provided with pins to hold said wire.

*Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.*

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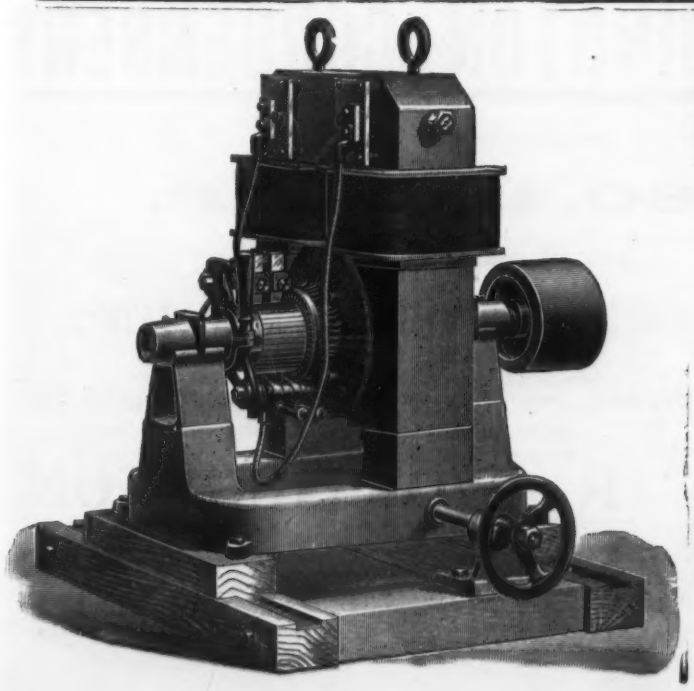

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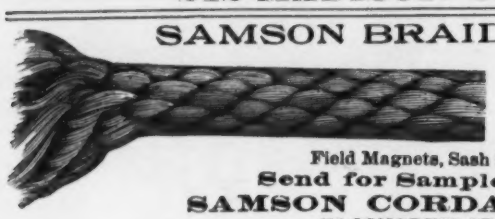

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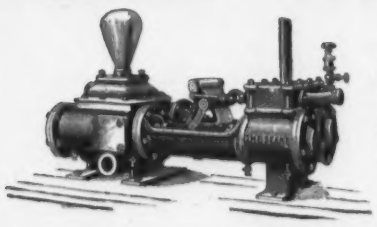

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